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F. A. WIRT, President — RAYMOND OLNEY, Secretary-Treasurer

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AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

RAYMOND OLNEY, Editor

Vol. 6 DECEMBER, 1925 No. 12

EDITORIALS

Agricultural Engineers for Electric Power Companies*

A RECOMMENDATION made by Owen D. Young (of the General Electric Company) in the Boston "Transcript" that power companies should establish agricultural departments to facilitate rural service brings into still sharper focus a current problem of wide interest to manufacturers, utilities and consumers. This problem is the prevailing question of how to provide electric service in farming areas without prohibitive cost, and solutions to it have been sought by the industry for many years. Mr. Young's suggestion seems entirely logical in view of the success thus far attained by central-station companies in developing industrial and residential business through the efforts of trained specialists in power and merchandising departments—men and women who "talk the language" of manufacturer, merchant and homekeeper and thus prescribe more accurately and profitably for their respective needs in the way of equipment and service.

Without an intimate understanding of farming problems, the central-station engineer and manufacturer's representative run the risk of making grotesque and costly recommendations in regard to service and apparatus. The situation demands intelligent appreciation of the farmer's needs at least, and Mr. Young's advice to electric light and power companies is properly supplemented by several practical suggestions to farmers and manufacturers as the other parties to the problem. For it is plain that little can be done to overcome the economic handicaps of farm service without the cooperation of these three interests. Of the farmer it is required that he be open-minded, hungry to find new methods, take pride in the advancement of his business and show the initiative to promote it. The farmer should insist upon the study of electrification by his agricultural schools and colleges and require a constant and unending publicity for the results of such studies through the farm journals, cooperating with utility companies and manufacturers to work out practical plans to get effective results. In the past the farmer has been hampered by extreme individualism, but the door is now open for more effective cooperation.

The manufacturer must do his part in developing equipment adapted to farm needs and marketable at reasonable costs. The power companies can help the cause along by seeing to it that certain qualified employees make a serious study of rural service in all its phases, getting acquainted with farm customers, systematically investigating the economics of rural line extensions, obtaining information as to the performance of equipment in the field, and having a voice in the determination of rural rates, conditions of supply and financing arrangements. With such a personnel the power companies will be in a strong position to determine upon the justification for extending service into new territory and to develop the best possible public relations in such areas.

The extension of power-company operations into rural districts by the construction of lines and networks associated with interconnection and transmission puts a social as well as an economic responsibility upon the utility companies concerned and carries with it a certain obligation to serve district populations. As Mr. Young well says, this does not mean that the power company can run a service line to the last farm or even to the last village. The company must neither ride the economic hobby to the point where its service is not generally available in the community nor, on the other hand, ride the social hobby, as some loudspeaking and visionary persons outside the industry urge, to the point of financial bankruptcy. Just as the industrial service of the utility goes forward under the guidance of the skilled power engineer, so should the development of the farm load proceed under the trained hand and eye of this new type of central-station specialist, upon whose competency will depend in no small degree the prosperity of many communities and the success of their service.

*An editorial reprinted from the June 27, 1925, issue of "Electrical World."

The Factory Idea

THE printed word, as applied to agriculture, has contained considerable reference to the "farm factory" during recent years. People have talked and written freely about the factory idea applied to farming without knowing particularly what they were talking about. The agricultural engineer, however, knows what is involved in applying factory ideas and methods to farming, and also what it will mean to agriculture. But what he has to say about taking the factory idea to the farm is not a bare statement of the need, for he backs it up with engineering facts and figures. And after all what we are after are the facts; empty statements about taking the factory to the farm are not convincing.

The only reason the manufacturing industries have spent so much effort developing more efficient labor-saving machinery, why they have made extensive studies in increase the efficiency of their workers is because they have been forced to do so by competition. Competition is very keen in most manufacturing lines. While the manufacturer, unlike the farmer, can set his price for an article, he is forced to keep the price down to the lowest possible figure because of competion. In other words, he cannot set his price and figure profits from prices; more often his price is determined principally by prices competitors are asking for a similar product. His profits, therefore, must come as the result of lowered costs, and if he cannot cut costs to the point where he can make a reasonable profit, sooner or later he may have to go out of business.

While the farmer in the past has not been faced with the keen competition which the manufacturer has experienced, such competition is becoming rapidly more apparent. The farmers of the Argentine, Australia, and other countries are using improved methods and the most modern American farm machinery, and with the advantage of cheaper land and cheaper labor the American farmer is faced with keen competition from these sources. In addition to this he is in competion with the manufacturing industries in his own country for labor.

Therefore, the farmer's situation is rapidly becoming an exact parallel of that of the manufacturer, and the ideas and methods that manufacturers have applied to their businesses must now in turn be applied to agriculture in an ever-increasing degree. This means better buildings, especially buildings of improved design and lay-out with respect to greater efficiency. It means mechanical power and improved farm machinery and their intelligent adaptation to the requirements of agriculture. Here is an opportunity for the agricultural engineer which is comparable to that which has presented itself to the mechanical engineer, electrical engineer, civil engineer, and others in the manufacturing and other lines of endeavor. And the agricultural engineer will grasp it.

A Study of the Isolated Farm Electric Plant

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DURING the past year a study has been made of the isolated farm-electric plant as used in Virginia. Paralleling Virginia's rural electrification program, this phase of the work is to be given careful attention at the Virginia Polytechnic Institute, and this report is presented as a progress report rather than as the final results of this study.

The objects of this particular study are to determine (1) the current cost for electric light and power secured from this type of plant; (2) the satisfaction these plants are giving in actual service; and (3) the comparative merit of battery and non-battery plants.

To obtain this information, two methods were followed. A survey of plant owners was made by means of questionnaires. Laboratory tests were also run up three plants in the agricultural-engineering laboratory at the Virginia Polytechnic Institute. The questionnaire study was carried on by F. M. Sommerville, as his graduate thesis work, while the laboratory tests were run in connection with the work of the senior class in rural sanitary equipment. The test work was found to be accurate and well carried out and the results obtained are a distinct credit to the students who performed the work. Several check tests were later made by the authors and no errors could be found in any of the work.

To obtain the desired information from farmer-owners of isolated plants, questionnaires were sent to about seven hundred farmers. This group included owners of every well-known make of plant and plants that had been in operation from one to fourteen years. About fifty of these questionnaires were sent to owners of non-battery plants. The returns were exceptionally good and, from those returned, one hundred fifty-seven of the battery plants and eighteen of the non-battery plants were tabulated. A few necessarily were discarded because of glaring inaccuracies in replies.

A summary of these questionnaires is given in Table I, the answers being divided to cover the battery and non-battery type of plants and thus give a comparison. The first and most striking fact brought out in this survey is the wonderful performance these plants have been giving in actual usage. Any group of machines that has been in use for an average period of 4.6 years and has a record of 93.7 per cent continuous operation speaks well for the engineering backing them. In connection with this record, it is very interesting to note that the troubles experienced were of a minor nature. such as would be expected with any internal-combustion engine and electrical apparatus, and that all except battery trouble could be repaired easily by the average user.

The makes, size of plant, and like factors are in general accord with other surveys made in this field. We do not believe, however, that the reports received indicate the true distribution of the various makes in Virginia. The Delco-Light Company was able to furnish us with more names of owners than any other; some of the other large companies could give only a short list. Several of the smaller companies gave a list of all their customers.

The outstanding feature of the comparative summary is the yearly cost of battery and non-battery plants. Before going further with the comparative costs, it is interesting to note that the non-battery, 110-volt plants carry an average load which is greater than the 32-volt battery plants, while the average size is approximately the same.

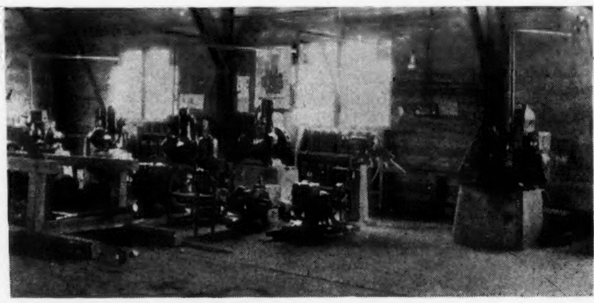
However, there are several things to say in favor of the battery plant. This group as an average is older and, therefore, less efficient. The engines are worn and the batteries have passed through a sufficient number of cycles of charge and discharge to have lost some of their vitality. The overhead and depreciation for the battery plants may likewise be slightly in error because of the relative higher purchase price of the older machines.

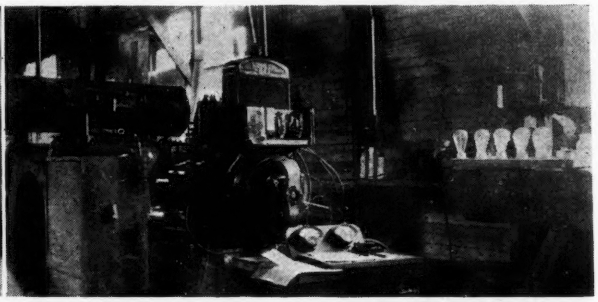
The starting trouble experienced with the non-battery plant is confined to this type of plant and is a very disagreeable one because there is no current to be had without starting by hand, there being no storage battery to fall back on in case of emergency. This trouble, however, is slight and under good average care should not be experienced.

The answers given in regard to the life of the plant are interesting, in that the battery life is longer and the mechanical unit life shorter than that usually agreed upon by engineers. In view of the actual battery replacements reported and the increasing inefficiency with age, we feel well justified in figuring battery life at five years. Indeed, the chances are that the battery has been favored. The mechanical unit with good care and proper replacements will easily have a ten-year life. Taking everything into consideration, it is believed that these figures are true in claiming a slight saving in favor of the non-battery plant.

The latter part of the summary deals with the sociological phase of the electric lighting and power plant, and merely goes to prove that the farmer needs and wants electric light and power and is willing to pay for it.

The laboratory tests to determine current cost were run on three plants: namely, Kohler, 1500 watt, Model "D"; Delco, 1250 watt, Model 1278; and Westinghouse, 1500 watt, Type "E", Model 60 with Goulds battery. The battery plants were given an eight-hour charge from a cell voltage of 1.7, followed by a discharge at rated eight-hour rate until the cell voltage returned to 1.7. The charge and discharge determined fuel economy and battery efficiency. Following these tests the battery was again given an eight-hour charge





(Left) Isolated farm-electric plants in the agricultural engineering laboratory at the Virginia Polytechnic Institute where the tests described in the accompanying article were run. (Right) The Kohler non-battery plant under test

and the figures used as a check upon the first run. The tests to which the non-battery plant was subjected were of necessity different. The plant was tested under varying loads and conditions as follows: The two-hour minimum load; two-hour one-fourth load; two-hour one-half load; two-hour three-fourth load; eight-hour rated load; two-hour variable load of six-minute load periods; two-hour start and run test at variable load with twelve-minute runs at an interval of 15 minutes; and cranking test.

In view of the very thorough tests run upon the non-battery plant the test given the battery systems would, on first thought, appear inadequate for an accurate comparison. However, because of the many factors entering into battery efficiency and varied conditions existing in battery plant operation, it is necessary that such a comparison be made. The conditions vary in almost any instance and to secure any reliable data a prolonged study is necessary. It is hoped that the department of agricultural engineering may have these data available within the next year, but in the meantime a very good comparison can be made between the plants tested.

The test methods followed were conventional, no special methods or apparatus being used. The fuel was weighed during the run by mounting a fuel tank upon scales at the normal fuel supply level. The oil and water used was determined by measuring the supply before and after the run. The voltage and amperage readings were taken from a continuous reading voltmeter and ammeter, and checked with a closely calibrated voltammeter. The speeds were obtained by means of Veeder

TABLE I. A SUMMARY OF QUESTIONNAIRES FROM 175 FARMERS USING ISOLATED FARM ELECTRIC PLANTS

Nature of Questions	Battery Plants		Non-Battery Plants	
Name of plants	Delco, 78.9%; Matthews, 8.2%; Fairbanks-Morse, 2.54%; Willys-Knight, 2.54%; Lalley, 2.54%; Western Electric, 1.9%; Westinghouse, 1.27%; Alamo, 0.63%; Edison, 0.63%; Phelps, 0.63%.		Kohler, 100%	
Size of plant (watts)	750, 17.8%; 850, 16.5%; 1000, 8.2%; 1250, 14.0%; 1500, 4.5%; 3000, 2.5%; 6000, 0.6%; (110 volts). Ratings given in horsepower, 5.1%. (29.9% did not answer)		800, 28%; 1500, 72%	
Voltage of plant	32 volts, 98.1%; 110 volts, 1.9%		110 volts, 100%	
Ampere-hour capacity of battery	140 (average)		(use only small 24-volt starting battery)	
Drive, direct-connected or belted	Direct, 97.5%; belted, 2.54%		Direct, 100%	
Life of plant	Average, 4.5 years		Average, 1.3 years	
Satisfied with plant	"Yes" 95%; "No" 5%		"Yes" 94.5%; "No" 5.5%	
Principal troubles	Minor troubles, as spark plugs, exhaust valves, magneto, fuses, meter, and auto-switch		Starting, 5.5%; none 94.5%	
Period of use without repairs to—				
(1) Battery	Owners estimate, 6.5 years (20.3% did not answer); dealers claim 7.1 years (38.2% did not answer)		Good for life of plant	
(2) Engine	6.9 years (46.5% did not answer)		6.6 years; 66% did not answer	
(3) Generator	7.4 years (55.4% did not answer)		6.6 years; 66% did not answer	
Number of lights used	Average, 25.1		Average, 22	
Appliances used	None, 42.7%; pumps, 28%; irons, 24.8%; washing machines, 11.4%; churns, 8.9%; vacuum cleaners, 8.9%; fans, 7.6%; motors, 3.1%; separators, 2.5%; toasters, 1.9%; curling irons, 1.9%; refrigerators, 1.2%; percolators, 1.2%; radio, 1.2%; phonographs, 0.63%; fanning mills, 0.63%; corn shellers, 0.63%; meat grinders, 0.63%; heaters, 0.63%.		None, 22.2%; irons, 50%; pumps, 22.2%; washing machines, 16.6%; vacuum cleaners, 16.6%; stove, 11.1%; fans, 11.1%; toasters, 5.5%; percolators, 5.5%; drill, 5.5%; electric cabinet, 5.5%	
Cost of present plant installed, including wiring	$602.46		$577.22	
Annual cost for—				
(1) Gasoline	$39.20 (32.4% use gasoline)		$62.33 (16.6% did not answer)	
(2) Kerosene	27.10 (62.4% use kerosene) (5% did not answer)			
(3) Oil	7.15		7.40 (16.6% did not answer)	
(4) Labor	7.94		5.00 (94.5% did not answer)	
(5) Repairs to battery	3.66 (86.6% reported none)		(None reported)	
(6) Repairs to engine and generator	1.00 (54% reported none)		.28 (94.5% reported none.)	
Total operating expense	$86.05		$75.01	
Total annual cost—				
(1) Interest on investment	$18.07 (one-half original investment at 6%)		(One-half original investment at 6%)	$17.31
(2) Depreciation				
(a) Battery	($200 at 20%)	$40.00	($50 at 20%)	10.00
(b) Engine and generator	($302.46 at 10%)	30.24	($427.22 at 10%) (starting battery)	42.72
(c) Wiring	($100.00 at 5%)	5.00	($100.00 at 5%)	5.00
(d) Operating Expense		86.05		75.01
TOTAL		$179.36		$150.04
Would you do without electric lights on the basis of what they now cost you?	No, 97.5%; Yes, 2.5%		No, 100%	
Estimated worth of electric lights	$472.43 (79.5% did not answer)		$441.30 (83.3% did not answer)	
Did you have a light plant before?	Yes, 15.4%; No, 84.6%		Yes, 33.3%; No, 66.7%	
Would you buy same type again?	Yes, 77.1%; No, 8%; undecided, 12.1%		Yes, 88.9%; No, 11.1%;	
Advantages	Convenience, safety, better light, use of electrical appliances, help to housewife, cleaner, and time saver		(Same as for battery plant)	
Time saved in doing chores	1.7 hours per day (29.2% did not answer)		1.5 hours per day (88.9% did not answer)	
Do you use less help?	Yes, 21.2%; No, 20.3% (53.9% did not answer)		Yes, 33.3% (66.7% did not answer)	
Helpers better satisfied	Yes, 68.7%; No, 8.2% (23.1% did not answer)		Yes, 44.4% (55.6% did not answer)	
Children more interested in home	Yes, 60.5% (39.4% had no children or did not answer)		Yes, 61% (38.9% did not answer)	
Distance from power line	11.5 miles (7.6% did not answer)		10.3 miles (5.5% did not answer)	
Amount willing to invest in rural line	$1463.80 (41.4% did not answer)		$600.00 (50% did not answer)	

Table II. Summary of Kohler Non-Battery Tests Nos. 1, 2, 3, 4, and 5

Watts Load	Length of Test Hours	Volts	Amperes	R.P.M.	Fuel Used—lbs.	Fuel Per Kilowatt Hour—lbs.	Engine Cooling Temp.—degrees F.	Generator Temp.—degrees F.	Room Temp.—degrees F.
73.5	2	122.5	0.6	1084	2.94	19.98	148	73	56
409.27	2	116.6	3.51	1076	3.31	4.05	161	89	64
899.38	2	116.5	7.72	1053	4.25	2.36	164	76	51
1163.48*	2	113.4	10.26	1063	4.75	2.04	174	96	65
1511.43**	8	109.05	13.86	1033	21.69	1.79	179	101	67

*Oil and water used were measured at the end of Test No. 4. (Oil, ½ pint; water, ⅛ pint.)
**Oil and water used in Test No. 5 was oil, 1/3 pint; water, ¼ pint. (Some lost through overflow tube of radiator as engine first warmed up.)

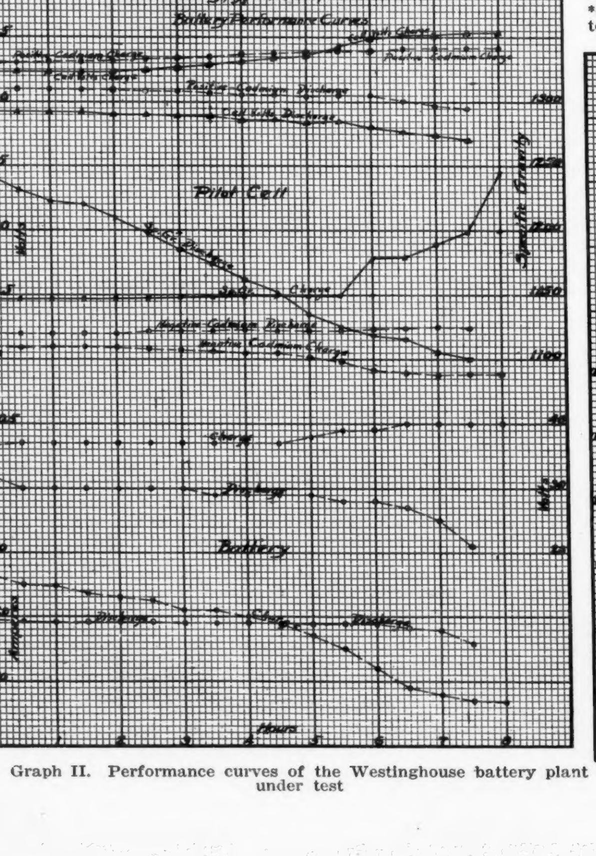
speed counters. The temperatures were taken in accordance with standard test practice, although only water outlet temperature was taken in the Kohler tests. In the battery plant tests the battery information was secured by the use of voltammeter with cadmium test spikes and standard hydrometer. A lamp bank was used for loading in all tests except as stated in two tests of the non-battery plants.

The gasoline used in these tests weighed 6.25 pounds per gallon and cost 20 cents, while the kerosene weighed 6.56 pounds per gallon and sold at 15 cents. The lubrication oil cost 80 cents per gallon for both grades used. In figuring oil cost both consumption and replacement costs were included in the total. Oil replacement costs were based upon 600 hours of running for gasoline and 400 hours for kerosene for each crankcase filling.

A summary of all tests for the battery plants and tests Nos. 1 to 5 for the non-battery plant is given in table II. The test curves of the Kohler non-battery plant are plotted in Graph I, while Graph II gives the performance curves of the Westinghouse battery plant under test.

These results bring to light nothing unexpected if a careful analysis is made of the characteristics of the four-stroke-cycle internal-combustion engine, the electric generator, and the

(Continued on page 300)



Graph II. Performance curves of the Westinghouse battery plant under test

Table III. Summary of Battery Plant Tests

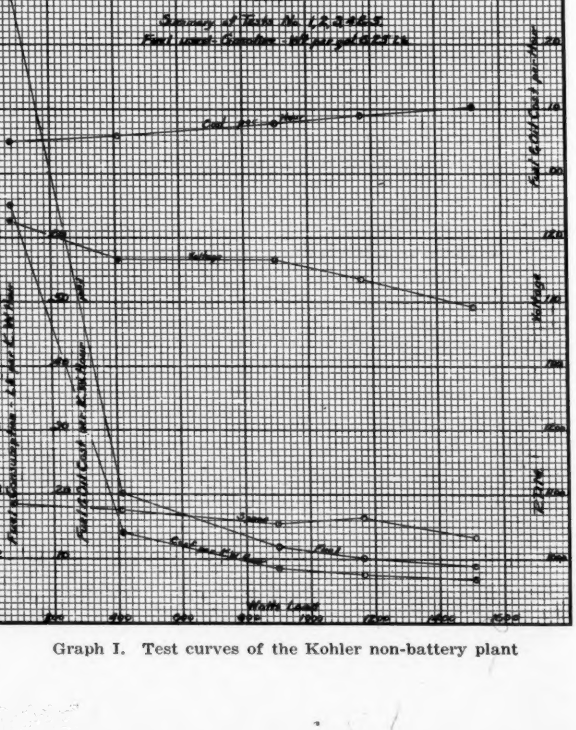
(CHARGE)

Fuel used	Kerosene	Gasoline	Kerosene
Speed—r.p.m.	1127	1169	1236
Amperes	17.73	18.6	17.5
Volts	38.15	40.2	39.76
Watts	676.4	747.72	695.8
Length of test—hours	8.0	8.0	8.0
Kilowatt-hour input	5.4112	5.982	5.566
Lbs. fuel consumed	16.31	20.75	18.75
Lbs. fuel per k.w.h.	3.014	3.468	3.369
Oil used—pints	0.5	0.5	0.5
Engine temperature—degrees F	98.3	92.0	129.0
Battery temperature—degrees F	66.0	59.75	57.0
Generator temperature—degrees F*	77.0	81.5	59.0
Room temperature	60.5	61.2	53.0
Fuel and oil cost per k.w.h.			
Fuel	$ 0.069	$ 0.1109	$ 0.077
Oil consumed	0.009	0.009	0.009
Oil replacement	0.003	0.002	0.003
Total	$ 0.081	$ 0.1219	$ 0.089

(DISCHARGE)

Battery	Gould, Type WHL 7		Delco-Light, KXG 13
Battery rating—watt hours	4500		4800
Battery condition	Very good		Good
Amperes	18.74	18.35	19.57
Volts	28.56	28.75	27.5
Watts	535.21	527.56	538.17
Length of test—hours	7.5	8.0	6.0
Battery temperature—degrees F	63.4	62.0	59.0
Room temperature—degrees F	59.0	58.0	63.0
K.w.h. output	4.014	4.22	3.23
K.w.h. input	5.4112	5.982	5.566
Efficiency—percent	74.18	70.54	58.03
Fuel and oil cost per k.w.h. from battery	$ 0.1092	$ 0.1728	$ 0.1534

*Construction of the Delco generator prevented getting actual temperature with glass stem thermometer.



Graph I. Test curves of the Kohler non-battery plant

A Proposed Inventory of Water Resources

NOTE: American Engineering Council is sponsoring a plan which has taken the form of a proposed bill drafted by the Council's Federal Water Power Committee, to be introduced at the next session, Congress providing for an inventory of the water resources of the United States by the U. S. Geological Survey. This proposed bill provides that the director of the Geological Survey be authorized to make, within a period of twenty years, an inventory of the water resources of the country, including data adequate for use in making a comprehensive plan for developing both surface and ground waters for domestic and industrial supplies, irrigation, navigation, power, and other uses, and for conservation and control of flood waters. In the accompanying article is outlined the function of the U. S. Geological Survey, the present status of the water resources investigation and the necessity of the inventory which has been proposed. It is a subject of vital interest to agricultural engineers and their support of the proposed measure will be generously given. No single project that American Engineering Council has sponsored has received more favorable or more united support. George Otis Smith, director of the U. S. Geological Survey, says, "The Passage of this bill would insure as adequate investigation of the water resources as the Temple Act has insured adequate topographic mapping."

AS PROVIDED in its organic act, the U. S. Geological Survey is the agency of the federal government authorized to investigate and take stock of the resources and products of the national domain, and publish information relative thereto for the benefit of the government and the general public. Among these resources, one of the most important and most valuable is the supply of surface and ground waters, whose quantity and quality fix the ultimate limit of population, determine the extent of agriculture and animal industry, and play an essential part in transportation, energy supply, and all major industrial activities.

The study of water resources, both surface and under ground, and of the best methods of controlling and using a nation's water supply, is primarily a function of the central government and is so recognized by civilized nations generally. In the United States eighty-five per cent of the potential water power is under federal control; the major rivers are interstate or international. Because the problems relating to water rights and the division of water among many users extend beyond state lines, recent years have been marked by the attempt of seven states and the federal government to formulate and adopt a pact for the equitable division of the waters of Colorado River; by proposals of Colorado and adjoining states to enter into treaties, permitted and approved by Congress, for the division of the waters that in nature flow across state boundaries; by a tri-state commission to divide the waters of Delaware River between New York, New Jersey, and Pennsylvania; and by many important interstate suits, several of which have already been carried to the Supreme Court of the United States for the adjudication of rights in water.

The study of water resources was started by the Geological Survey in 1888, in connection with special irrigation investigations, and has been authorized by successful annual appropriations since 1895 and conducted continuously over the succeeding period of thirty years. In organizing and conducting the work the Geological Survey has developed and, as necessary, has improved the methods of investigation and the instruments required which are now accepted as standard throughout the world. The Survey is recognized as the primary source of authoritative information in regard to quantity and quality of waters in the United States.

The quantity of water in a river is not uniform. It changes not only from hour to hour, day to day, and season to season, but from year to year and by periods of years. A short-time record of river discharge, therefore, is an inadequate basis for making plans leading to the investment of capital, for the adjudication of rights, or for the distribution of flow among the several users. Moreover, the need for records must be anticipated in order that they may be available and adequate to serve the purposes of sound economic development. Intelligent development, operation, and administration of the nation's resources based on reliable records has added billions of dollars to the taxable values of the country and contributed in a large measure to the general prosperity. On the other hand, disaster to agricultural communities, financial wreck of power projects, and the waste of millions of dollars in misdirected municipal and industrial enterprises have resulted from a lack of information as to the quality, quantity, and seasonal distribution of the rivers utilized as sources of water supply mistakenly depended on for successful accomplishment. So it follows that the value of much real property is largely based on the water supply available, right to use or enjoyment of which rests on findings by state officials and decree of courts that in turn rest on the integrity of the records of river discharge. The basis for many values, for the sound and economic use of water, and for administration of water laws and rights, must therefore, be an authoritative record of water supply extending over a period of years.

The records collected by the Geological Survey are used not only by officials of the United States in the investigation, construction, and administration of federal projects, but by all state officials in their administration of the waters, by commissions and other agencies charged with the supervision of the development and use of rivers, by engineers and financiers in the consideration of new projects and the operation and evaluation of old ones, and by courts from the lowest to the highest in the adjudication of interstate and all other rights relating to the control, diversion, and use of water.

In accordance with its organic act, the Federal Power Commission operates through and by means of the Departments of War, the Interior, and Agriculture. Under this procedure the Geological Survey is called upon for reports on various projects, for supervision of all activities of certain permittees and licensees and for supervision of the stream gaging required of nearly all permittees and licensees. This involves in the aggregate a large amount of work in practically all sections of the country. Of 30,912.698 horsepower of installed capacity included in projects under permit, license, or active application, 9,745,360 horsepower (31.5 per cent) are situated in nineteen of the states east of the Mississippi.

There is a widespread public interest in records of water supply, reflected in a constantly growing demand for additional data, which has led to requests by states and other governmental agencies for extending the investigations by cooperation. Today the major part of the expense of the work is borne by cooperating states. In fact, the federal appropriation is so small that it is impossible to allot to work within any state more funds than are equivalent to the salary and expenses of the district engineer who keeps the work on a standard basis and guarantees to state officials, courts, and others the reliability of the results. The work done in my state is, therefore, determined by the amount of state funds available and, on the basis of current federal appropriations, no work is or can be undertaken except in cooperation with other agencies. As now conducted, the Geological Survey is but little if any more than the advisor and stabilizer in this work.

The demand for cooperation has been based on the necessity for having reliable data that would serve the multiplicity of uses, collected and published on a standardization basis. This necessity can only be served through a central, or federal agency. The records published by the Geological Survey in the series of water supply papers are recognized as authoritative and are accepted as such by federal and state administrative officials, courts, and engineers. No independent state records or state reports would or could have that standing. State administrations and policies change frequently. Within

the periods of Survey cooperation all state officials have changed, many of them several times. Without the stabilizing influence of the Geological Survey and its district engineers, many records would have been lost and others would have been so far below standard as to lose much of their value.

As a result of many years of cooperation the states are not now organized to carry on independently general water resources investigations and their appropriations for this work are now generally being made on the basis of and contingent on federal cooperation. Such cooperation represents a real economy to the public because the top costs involved in the operation of one centralized federal agency are much less than would be required under thirty or more organizations working independently.

The most pressing single problem facing every civilized nation today is that of supplying cheap electric energy to meet demands that are constantly increasing. On it depends national security and national prosperity. In time of war, a nation must be able to expand its industries to meet destruction of appalling magnitude caused by the use of modern explosives. In time of peace, industries must meet the competition of cheap labor and cheap power in other countries.

In the struggle for more and yet more electric power, water is the controlling factor. Water power sites will be utilized whenever and wherever they are economically feasible. Steam power plants will be built as needed but always where large quantities of water are available for the condensers. As 600 to 1,000 tons of water are used for every ton of coal burned, no large steam power plant can be built, except where there is positive and definite assurance of the availability of sufficient water at all times.

The many problems related to the growth of electric industry, which are national in importance and scope, are, therefore, intimately related to those of water supply. The compilation of statistics of power use, inaugurated during the war as a part of the progress to keep essential war industries in operation, has been continued because of their value and need in peace-time activities. At the start the work naturally fell to the organization that had the basic information and the qualified personnel to do it. The same reasons that caused its assignment in the Geological Survey still exist and are adequate for continuing it there.

The growth of electric public utilities has been enormous in recent years and is continuing at a rapid rate. The capital invested in central stations and transmission lines at the present time is more than $7,000,000,000, and the gross revenues are in the neighborhood of $1,000,000,000 annually. Small companies are being absorbed by larger ones and the larger companies are being taken over by holding companies. It appears probable that eventually the control of the production of electric power will be centralized in a few large companies. Whether this development in the industrial life of the nation is for its best interests and whether the states can satisfactorily regulate these public utilities that operate across state lines cannot be answered at this stage of the development. The federal government must, therefore, have available the current information of the growth and development of public utilities as a matter of record and for use in connection with the rapidly growing interstate phases of the public utility business.

No other reports comparable with the Survey's statistics of power production are published to any department. At five-year intervals the Census Bureau publishes certain statistics relating to electric stations, including an annual figure of output and fuel consumption. These data are, however, collected and published so long in arrears that the information is not of great use in studying current conditions. The census of electrical industries for 1922 was released early in 1925, more than two years after the year to which the data relate. During the period the production of power by central stations increased about twenty-five per cent. The Survey reports of power production, on the other hand, are compiled and published monthly and are so nearly current that they are used as a barometer of business conditions.

The major and immediate value of power statistics relates, however, to conservation of the nation's coal and to the best utilization of the water resources.

The preparation of their regular monthly reports of output and fuel consumption, the realization that the figures will be scrutinized by competent engineers, and the availability of the monthly and yearly Survey reports, showing the results obtained throughout the country and furnishing a basis of comparison for the efficiencies of their own plants, have led the officials of hundreds of operating companies to study and improve efficiences, resulting in the conservation of immense amounts of fuel. The following table shows by years the average fuel consumption per kilowatt-hour of energy produced:

Year	Pounds of coal per Kilowatt-hour
1919	3.2
1920	3.0
1921	2.7
1922	2.5
1923	2.4
1924	2.2

There is no doubt that the wonderful progressive improvement shown during the six years of record has been due in a considerable measure to the statistical work of the Survey. To state the situation more definitely, in 1924 the saving of coal and its equivalent in other fuels obtained by improved power and plants and better stoking, as compared with the practice of 1919, amounted to the enormous total of 19,000,000 tons, which at $5 a ton, is worth $95,000,000. The total cost of the preparation of these power reports for the past six years has been less than one-tenth of one per cent of this amount saved in a single year. Surely, this is worth-while conservation.

The problems of interconnection of electric systems, of the utilization of water power in furnishing the constantly increasing demand for energy, of the proper location of new superpower steam plants with relation to sources of coal and condenser water, and to water-power sites that will be developed in the future, and the problems of markets for power, and of location of probable future industries, are all so intimately related to "the best methods of utilizing the water resources" of the country that the Survey would be derelict in its duty to the public if it neglected to collect and report these power statistics, as an essential part of its water resources investigations.

The following is the text of the bill proposed and sponsored by American Engineering Council to provide for an inventory of the water resources of the United States and for other purposes:

BE IT ENACTED BY THE SENATE AND HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA IN CONGRESS ASSEMBLED:

Section 1. That the Director of the Geological Survey under the Secretary of the Interior be and hereby is, authorized and directed to make within a period of twenty (20) years from date of the passage of this act, an inventory of the water resources of the United States including data adequate for use in making a comprehensive plan for developing both surface and ground waters for domestic and industrial supplies, irrigation, navigation, power and other uses and for conservation and control of flood water. Furthermore, to include data currently needed by federal, state and other governmental agencies and by the general public in the economic development, operation, administration and regulation of the water resources of the nation. To publish as rapidly as collected these data and report on the best methods of utilizing the water resources. Provided that in carrying out the provisions of this act the Director of the Geological Survey is authorized and directed to use the facilities which are now or which may be assigned to his jurisdiction and to allot to them additional funds from the appropriation herein authorized, or from such appropriations as may hereafter be made for the purposes of this act.

Section 2. That in carrying out the provisions of this act, the Director of the Geological Survey is authorized to co-operate with any federal, state or other governmental agency, or private enterprise developing or using waters under governmental regulation, to the end that the water resources data for the United States may be coordinated, authenticated, and made available on a uniform basis through a recognized central agency.

Section 3. That for the purpose of carrying out the provisions of this act both in the District of Columbia and elsewhere as the Director of the Geological Survey may deem essential and proper, there is hereby authorized to be appropriated out of any moneys in the Treasury not otherwise appropriated the sum of $400,000 to be available until the 30th day of June, 1927, and $500,000 in each of the nineteen years thereafter.

A Thresher for Single Heads of Grain

By A. H. Hoffman

Mem. A.S.A.E. Agricultural Engineering Division, University of California

IN THE plant breeding work of agronomists in the agricultural experiment stations it becomes necessary each year to thresh and to separate the chaff from many thousands of single heads or of handfuls of heads that grew on single plants of the small grains. All the kernels in each head or handful must be removed without any being cracked, lost, or mixed with other samples. For this reason great care must be exercised and in the work of many stations threshing methods are in use that are almost as primitive as that of rubbing the heads between the palms of the hands and blowing away the chaff by the breath.

In the summer of 1925 a new thresher for such work was designed by the writer and built by the agricultural engineering division, College of Agriculture, University of California. It was put into service at the experiment station at Davis on July 15, 1925, and used throughout the season.

The new machine fulfills well the before-mentioned requirements of such a machine. A small fraction of a second is required to thresh a single head or handful; about one second is needed to remove the chaff, and two seconds more to pour the clean grain into its envelope and to replace the grain drawer. All is then ready for the next sample.

The purpose was to devise a machine that would do the required work satisfactorily, be equally suitable for grains of various threshing characteristics, and yet be the extreme of simplicity, ease and speed of operation and durability. To avoid at once the nuisance of belts and multiplicity of bearings that would be inescapable if a separate shaft were used, the toothed cylinder was mounted directly on the end of the shaft of the driving motor. To secure ample range of speed variation a commutator type a.c.-d.c., 220-volt, forge blower motor was chosen and used ordinarily on 110 volts. For a few of the toughest grains such as rice it may be necessary to use the higher voltage (with the resulting higher speed and torque). The two voltages and the six-step rheostat for speed control give a total of twelve running speeds. Six speeds using 110 volts were found adequate for all the wheat, barley, and oats of this year's single-head harvest at the Davis station. The rice of the experimental work is not ready for threshing at this writing.

By using the new machine the agronomy division at the university farm (Davis, Calif.) finished the single-head threshing fully a month ahead of last year's schedule, according to Vincent Maghetti, who was in charge of the work. He states also that he used the machine with a great variety of other seeds besides the standard grains. Even with such formidable things as the heads of the bull thistle (cirsium lanceolatum, Hill) it gave excellent results.

The novel features of this machine are as follows:

1. It is extremely simple and the cylinder is directly mounted on the motor shaft.

2. A toothed concave is not used. This enables higher tooth-tip speed without cracking of the grain. Sloping bars are inserted in the housing to prevent any possibility of whole heads being blown by without being hit by the cylinder teeth.

3. The threshing cylinder and its teeth constitute the only blower. The blast is entirely adequate to remove the chaff.

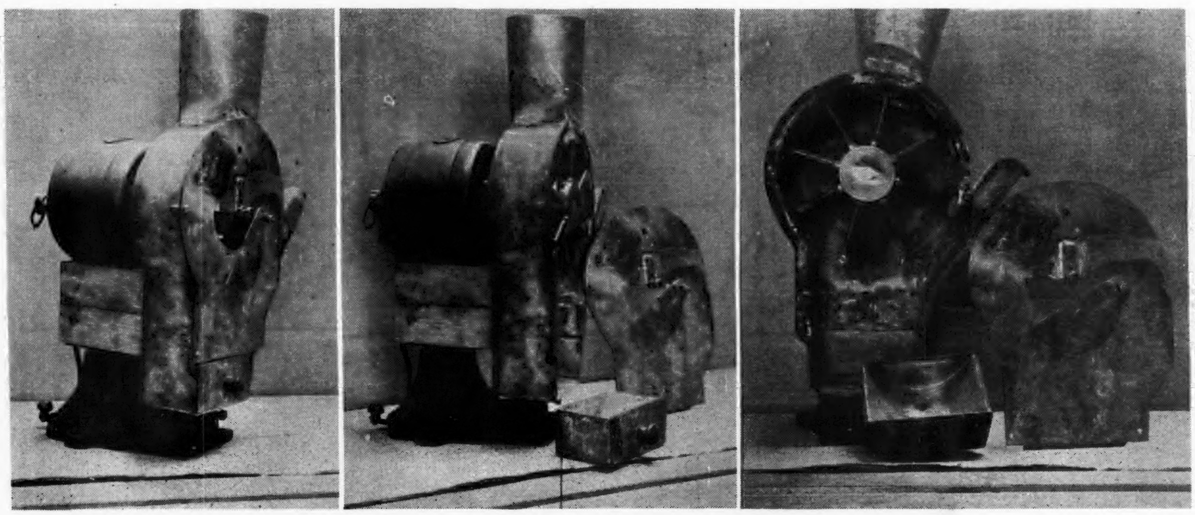
4. The operator's hand that puts the head or heads into the machine acts as a lid or cover to prevent any kernels jumping out.

Fig. 1 shows an external view of the new machine; Fig. 2 and 3 show the construction of the interior.

The motor used is a "single-forge" blower made by the Champion Blower Company, of Lancaster, Pa., though a motor of another make but similar characteristics would answer the purpose equally well. Since these motors increase in speed with decrease in load, it will be found that a motor of the same kind and size designed for 110 volts would in general run too fast if used for this purpose on 110 volts, since the blower action of the toothed cylinder is considerably less than that of the fan with which these forge blowers are regularly equipped.

The feeder tube is designed to be covered by the operator's palm. An oval with short axis 3⅝ inches (parallel to

(Continued on page 308)



THE CALIFORNIA THRESHER FOR SINGLE HEADS OF GRAIN

Fig. 1 (Left) The single head (or handful of heads) is dropped into the oval top of the feed chute. The palm covers the opening. The chaff blows away out of the grain box while it is being drawn out. The chaff discharge at the side was found unnecessary and will be cut off in the final machine. Fig. 2. (Center) Showing machine with front cover plate and grain box removed. Fig. 3. (Right) Front view of interior. Housing is heavy sheet metal oxy-welded or brazed. The interior is smooth and without pockets where grain might lodge. Wall projections are brazed on just above the grain box. The bottom of the housing may be omitted and the drawer hung in the usual guideways. The chaff chute at the right is omitted in the final form

Establishing a Professional Agricultural Engineering Course*

By Harry B. Roe

Mem. A.S.A.E. Associate Professor of Agricultural Engineering, University of Minnesota

AT THEIR meeting in July, 1925, the board of regents approved the introduction into the University of Minnesota curriculum, beginning with the college year 1925-26, of a four-year technical engineering course leading to the degree of Bachelor of Science in Agricultural Engineering. This course will be jointly administered by the dean of the college of engineering and the dean of the college of agriculture.

In the land-grant colleges the curricula of the departments of agriculture generally provided, at the outset, for elementary instruction in physics of agriculture, drawing, mechanical training and land reclamation that would give to the farmer and to the investigator in agricultural science such knowledge of these fields as it was manifestly necessary for him to have.

In this Minnesota has been no exception, but was, rather, a pioneer in this type of education. In 1888, when the school of agriculture was established and the college of agriculture was placed on a definite footing, elementary instruction in physics of agriculture, drawing and carpentry were definitely included in the curricula. Blacksmithing was added in 1893, power machinery in 1898, and mechanical training covering some cement, rope, and pipe work, etc., in 1906. Instruction in farm structures was included in 1907, and in 1908 drainage and tractor and auto work were similarly provided for. No provision was made for instruction in land clearing until 1918 when the distribution of cheap war salvaged explosive was begun by the federal government.

It should be remembered that, during the earlier formative period, instruction along these lines was purely elementary in character and that such subjects were not generally recognized as a related group but each was taken on individually as a necessary, unclassified adjunct to what were then considered the more fundamental and important lines of work. Even after it began to be recognized that the various lines of mechanical instruction and allied work could and should be conveniently grouped together as a class, this group was not called engineering, and it was **not** engineering. Nevertheless it must be recognized that agricultural engineering as a profession is the direct outgrowth from this early group of mechanical activities.

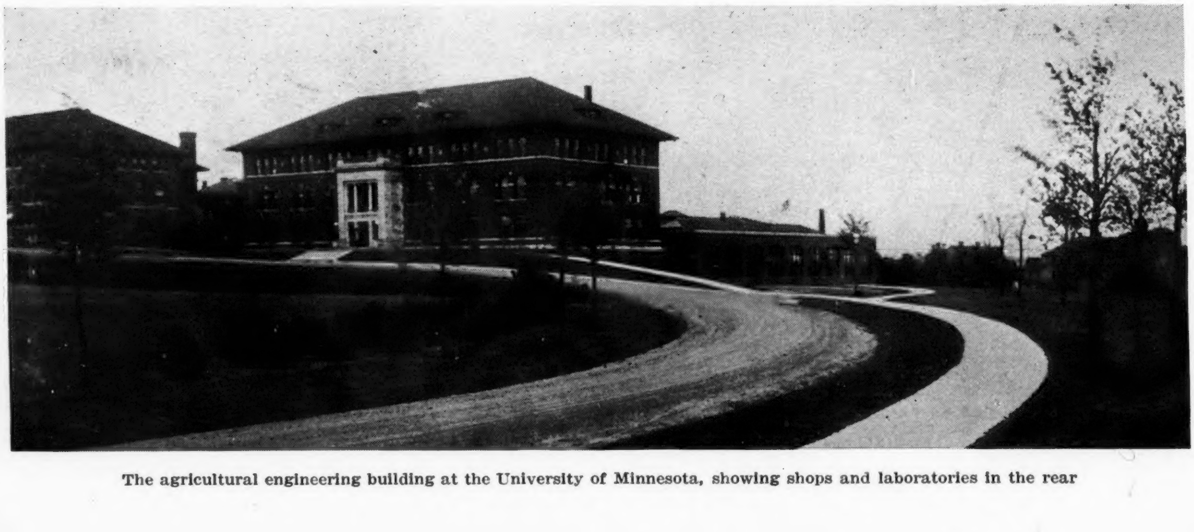
For many years, however, the majority of people interested in agricultural development and education refused to recognize the birth, growth, and importance of agricultural engineering.

An Economic Need. During these years filled with earnest effort in scientific agriculture, however, the farmer has profited by scientific methods in combating plant and animal diseases, by crop improvement through seed selection and plant breeding, by livestock improvement through good breeding and sire selection, and by good business methods based on sound agricultural economic principles. What he has been slow to recognize is that the improvement in crops and livestock would not have been possible without a parallel improvement in his buildings, machinery, and equipment, and in soil and tillage conditions resulting from intelligent reclamation methods. Hence, the improvement in these mechanical lines has not in the past received anything like as much public expression of appreciation nor as much publicity as have the steps of progress along purely scientific lines in agriculture.

While the development in farm machinery and other farm equipment has been so great that the labor required to produce one bushel of wheat 75 years ago is sufficient to produce 43 bushels today, yet the greatest field for reducing the cost of production lies in reducing the costs of labor, power, and equipment. The only way to reduce these items of cost is through better equipment, better buildings, more efficient farm machinery. A large part of the work of the agricultural engineer is the development of such equipment and such machinery. Good buildings and good farm machinery cannot be considered so much a luxury as a means of reducing the cost of production on the farm.

The investment in buildings and equipment for the farms in Minnesota is so large that it is a very influential factor in the cost of production on the farm. Of the total investment in farm property in Minnesota in 1920, 15 per cent is in buildings, and 5 per cent in machinery, these two items constituting one-fifth of the total investment. Unwise selection, inefficient operation and the large depreciation through poor maintenance of such costly equipment, may make the cost of production so high as to absorb all profits that may be secured by better seedbed preparation, high quality products, and good livestock. A similar result may follow neglect of proper drainage or its improper installation, in the treatment of soils and in the economy of field operations. The value of the land constitutes about 70 per cent of the total investment in the

*Abstract of an article appearing in the October 1925 issue of "The Minnesota Tech-Log."



The agricultural engineering building at the University of Minnesota, showing shops and laboratories in the rear

farm, yet drainage research at the Minnesota university farm shows that almost one-third of this investment is for acres wholly unfit for tillage until reclaimed by drainage and that failure to drain these waste acres constitutes a standing menace to efficient field operation, the increase in cost of production from this cause alone often running as high as 33 per cent. The investment in livestock is only 8 per cent of the total farm valuation. This is one of the smallest items of investment made by the farmer, yet the farmer and the whole state have given much more scientific study to livestock than to that of agricultural engineering.

The following items concerning Minnesota farms will be of interest in showing some of the problems that the farmer meets in attempting to secure the large amount of equipment that is necessary for his farm in striving to operate the farm economically and at a profit:

1. Approximately 30 per cent of the area now in farms requires reclamation by drainage for economical operation.
2. There are about 20,000 tractors in use in the state representing over 100 types manufactured by about fifty companies, ranging from 1 to 85 horsepower in size. Their use is increasing at the rate of about 9 per cent each year.
3. There are 70,000 stationary engines in use on the farms represented by a greater number of models than are the tractors.
4. The average farm investment in buildings in Minnesota is $3,086.
5. The average investment per acre in tillable land is about $165.

Required an Agricultural Engineer. These few items show the situation that a farmer is in when he attempts to cut down his cost of production by the use of modern machinery or by the improvement of his farm and buildings. The farmer cannot expect to know much about the technical details of this equipment and must rely upon engineering experts for advice in the selection and their help in the production of efficient equipment. Many people think that a farmer might secure service and help from engineers not trained along agricultural lines. While this may be possible it is highly improbable and has not worked out well in the past. The engineer trained in other lines of endeavor seldom has a grasp of the agricultural problems or of the methods of agricultural production in such a way that he can be of much assistance to the farmers. His highly specialized training has been along lines entirely different from the engineering and production problems of the farm. The training that a man receives which enables him to design a large city office building, or a city sewer or water system, or a manufacturing plant, does not enable him intelligently to plan a dairy barn, a grain storage building, or a tile drainage system for the farmer. While he might make such plans, they certainly could be much more efficiently worked out by an engineer trained in agricultural engineering.

Because of a lack of mutual understanding and the absence of a sympathetic contact between the farmer and the engineer in the past there has been a great gap. It has been found necessary that this gap be bridged, for the farmer is beginning to realize that he needs engineering service.

The agricultural-engineering field is not, at the present time, a highly specialized one. The agricultural engineer as quite generally needed today is a general practitioner. His prototype may be found in the country doctor of a generation ago, who was a transitional type but very necessary and useful, replaced almost wholly in these days of more advanced development by the great army of specialists. The men in this country who have a sufficiently broad knowledge of the whole field properly to call themselves agricultural engineers are but a handful of those who will shortly be needed.

A Recognized Profession. The division of agricultural engineering at the University of Minnesota is frequently asked to recommend and secure men to fill various positions in this field. We have not been able to provide men from our own institution for these positions. The agricultural colleges in seven of our agricultural states are already giving courses which lead to professional degrees in agricultural engineering and other states are preparing for such work, but the demand for agricultural engineers is steadily increasing, and it is the opinion of the farm-equipment companies and public utility companies that in the next few years there will be a great demand for agricultural engineers for these lines of service, and that the agricultural colleges are not preparing such meu in sufficient quantity.

The work in agricultural engineering is well recognized by the United States Department of Agriculture which has a thoroughly organized and very active division of agricultural engineering. This division is fostering the development of technical agricultural engineers in the different states.

The New Course, Its History and Character. The plan of the new agricultural-engineering course at the University of Minnesota had very simple beginnings. The first outline was prepared about five years ago by the writer. In it he was guided to a considerable extent by the existing course at Iowa State College, using modification suggested in his own consciousness by a decade of experience on the staff of our department of agriculture.

It is the consensus of opinion among all those active in building up this course that a good foundation of pure science, mathematics and some cultural subjects are more important to an engineer, and especially an agricultural engineer, than some highly specialized subjects in his own line of engineering. This view seems fairly well borne out by the quite close similarity of the ideas of engineering educators generally as shown by the accompanying comparative charts of engineering courses here and in other agricultural institutions offering courses in agricultural engineering. The agricultural engineer must fundamentally be an engineer, but in addition he must have a broad scientific training and a knowledge of the fundamental principles of agriculture. The curriculum that has been outlined for the course in agricultural engineering at the University of Minnesota will provide men with such training.

Field of the Agricultural Engineer. One might ask, especially if he is a student of engineering either present or propective: After all what is agricultural engineering, how is it different from other established lines of engineering, and what new or promising fields of opportunity does it hold out to the student who chooses to follow this line of special training?

Agricultural engineering may be defined as the art and science of engineering as applied to agriculture, embracing both the technical and economic phases of the application of engineering to agriculture. It may be comprehended under the following general headings:

(a) Farm Structures, embracing farm buildings and other structures, building materials and other structures, building materials, concrete construction, arrangement of of buildings, ventilation, etc.

(b) Farm Mechanics, including gas, animal, and electric power, farm implements, water supply, sewage disposal, lighting and heating, and farm-home conveniences.

(c) Land Reclamation, such as drainage, prevention of soil erosion, irrigation, land clearing, and roads.

The new course is clearly mapped out as a general course, but the three distinct lines of specialization above listed are also made possible.

Agricultural engineers must be able not only to serve as specialists in their line of work, but they must also be able to work directly with the farmers and with the individual farm problems and arrive at a solution of such problems. However, the greatest field of service of the agricultural engineer is in the design and construction of equipment that the farmer may use. The design and construction of one type of efficient farm equipment may result in carrying help to hundreds of thousands of farmers, while an engineer could not possibly reach all these same farmers by individual consultations and personal service throughout his whole lifetime.

Some of the important positions which agricultural engineers are called up on to fill are shown in the following list:

1. With the manufacturer of farm machinery, farm equipment, and farm building materials, as follows:
   (a) Executives
   (b) Research and development engineers
   (c) Publicity managers
   (d) Sales managers and expert salesmen
   (e) Technical field experts.

2. Superintendents or managers of large farms where machinery and farm equipment have been highly developed.
3. Drainage and irrigation engineers in reclamation service.
4. Teachers, investigators, and extension specialists in agricultural engineering in colleges, experiment stations, and in the U. S. Department of Agriculture. (Possibilities in desirable and needed research in this field seem almost unlimited.)
5. Editors and agricultural-engineering experts for farm papers and technical magazines.
6. Designers and contracting engineers for farm buildings.
7. General practicing engineers for farm machinery and equipment installations.
8. Agricultural advisors with electric and other public utility companies who have a worthwhile service to sell the farmer for his increased profit and comfort of living.

The Division of Agricultural Engineering. The division of agricultural engineering of the University of Minnesota is situated on the agricultural campus in a comfortable, large and well-equipped building provided by the foresight and liberality of the Legislature of 1909 and 1910. It is here, under the direction of members of the divisional staff that all special courses in agricultural engineering and such fundamental or general engineering courses as are taught from an agricultural standpoint, of which surveying and agricultural hydraulics are a type, will be taught to those registering in agricultural engineering. The division is well organized and has for sixteen years been doing a large amount of work in fundamental teaching, some in agricultural extension, and a limited but rapidly increasing amount in official research. The whole division is composed of five sections representing the major division of the work; namely, buildings, mechanics, land clearing, physics, and drainage. Each section is headed by a man of extended practical experience in his line who has had a lifelong contact with the agricultural field.

Agricultural Engineering Research. It will doubtless be of interest to the reader to learn that under the agricultural experiment station the division of agricultural engineering has, at the present time approved and active, thirteen official projects in investigation and research. These are distributed as follows: One in farm buildings; one in farm mechanics; two in land clearing; five in agricultural physics; and four in drainage.

Counsel to Students. While we would not for a moment discourage the student from the large city who, after due consideration, has decided that he earnestly wishes to train for this work, still we do feel that the prospective student best fitted to develop to the best advantage as an agricultural engineer is the young man from the rural district, best of all from the farm itself with a background of years of farm experience at home, with a natural liking and bent for engineering work; always provided, of course, that he has the proper grounding in his college preparatory work.

The young men of the state and of the country we would say: If you are interested in engineering work in any line and if you are also interested in agriculture, the field of agricultural engineering affords great opportunity. However, the active field is new and in its pioneer stage. Pioneering always means hard work and sacrifice but it also means achievement. If you are not willing to face this sacrifice and do the hard work for the sake of the achievement, if you have not the capacity or the inclination for hard work, the spirit and the power to rise above discouragement and to keep your eye fixed on the goal of final achievement, keep away from this field; there is no real place for you in it. As this phase of education develops, we do not want in the pioneer classes the many who go through college just to get a job, but we do want the few, the stalwarts who always arrive because they never turn their faces backward. If you have the vision; if you love mechanical or engineering work and sympathize with the importance of the great agricultural community; if you love the work for the work's sake; if through grinding toil not yielding to discouragement, you can keep your eye on the goal of achievement for the community and the state, then come into this field and you will find there a worthwhile job with unlimited opportunities for real service to an earnest and appreciative clientele.

A Study of the Isolated Farm Electric Plant

(Continued on page 294)

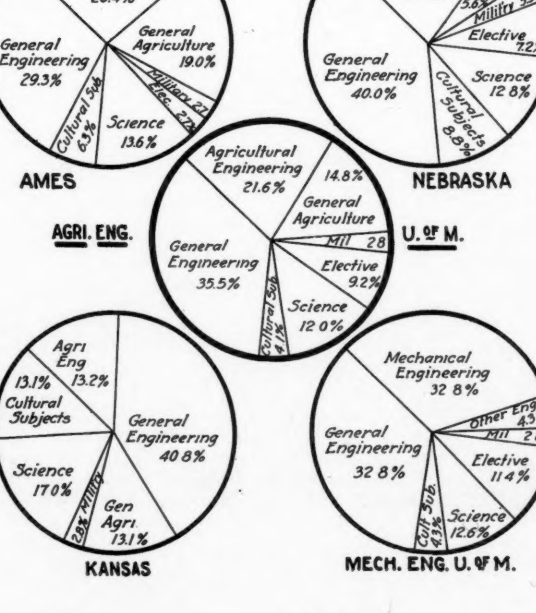
lead-acid storage battery. The fuel-consumption curve and the resulting cost curve of the non-battery plant is as expected and presents the greatest drawback of this type of plant. It is essential that a sufficient load be applied for economical operation. The problem here is very much the same as that presented in the automobile engine, that is, low efficiency at part throttle, and the same possible solutions present themselves; namely, improving the volumetric efficiency by application of the Dempsey cycle or similar remedy; the development of a reliable light-weight, high-speed Diesel engine. The use of the so-called steam cooling system offers possibilities for this type plant and is worthy of careful trial.

The battery plants tested are slightly more economical as far as the mechanical-electrical unit goes, running at a higher temperature and burning kerosene successfully. The battery is the weak link in these plants and offers a great field for improvement, which, if not forthcoming, undoubtedly means the end of the battery plant is not many years distant. At present the battery gives cheap current on light loads, but on the heavier demands it becomes more costly and involves the trouble of starting the plant manually to care for the largest loads economically.

The conclusions of this study thus far can be very briefly summarized as follows:

1. The individual farm electric light and power plant is a very satisfactory piece of farm equipment.
2. The cost of current derived from these plants is exceedingly high.
3. The farmer is "sold" on electricity and willing to pay well for its advantages.
4. Over a period of time it would seem that the current cost from the non-battery type of plant is cheaper than from the battery plant.
5. A large field for improvement and development is presented in both types of plant.

COMPARISON OF THE DISTRIBUTION OF SUBJECTS IN AGRICULTURAL ENGINEERING COURSES IN SEVERAL LEADING COLLEGES.



Relation of Electrical Power Development to the Farm Equipment Industry*

By O. B. Zimmerman

THE requirement of economics in industrial power to carry out developments and improve human welfare has brought about notable results in the past, affecting every industry in the world. In this progress the development of electrical equipment has naturally taken a prominent part, finding its way, on account of its adaptable nature, into places and uses considered technically impracticable a few years ago.

Everywhere hydro-electric possibilities are being exploited. Many such developments are now in use at Niagara Falls, Keokuk, Roosevelt Dam, Muscle Shoals, to say nothing of the hundreds of small power and service company plants and distributing systems. And now we hear of harnessing the tides in the Bay of Fundy and of the creation in a vast area of Central Canada of a new lake by damming the waterways north, and diverting them south to the Great Lakes, thus making available a vast primary source of energy.

Plans for super-power developments to utilize coal and coal wastes near the mines and all over the country speak with certainty of high-tensioned power lines spreading throughout the contiguous territory in ways not easily conceivable today.

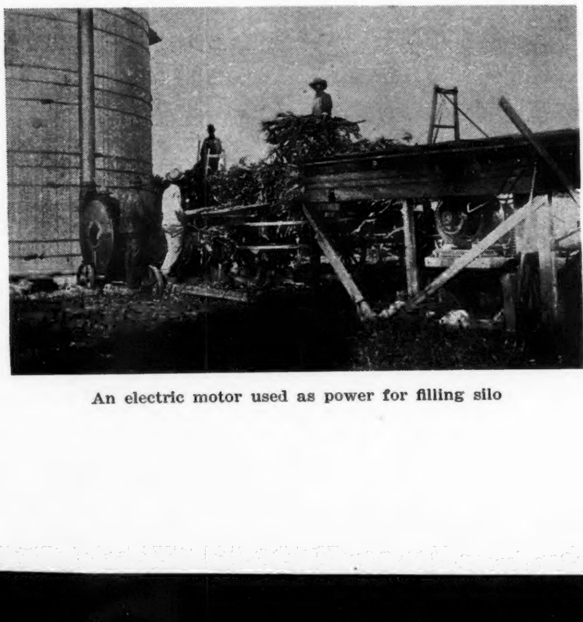
In foreign lands the same is true; Switzerland, Denmark, New Zealand, Sweden, Great Britain, The Netherlands, Germany and Finland have a multiplicity of these power developments in action or projected.

While we cannot undertake to measure at this time the rate or extent of this and kindred development, it is obvious that this trend may hereafter affect the farm equipment industry and its products.

The Committee on the Relation of Electricity to Agriculture on which the National Association of Farm Equipment Manufactures has representation, is a logical reaction to this trend. In my opinion the Committee's procedure and personnel assure high grade engineering treatment in reviewing, analyzing, developing and coordinating electric power possibilities in a thoroughly economic way.

While the larger electrical power developments have had in mind the serving of industries of magnitude, or highly concentrated areas of moderate or small consumers, the smaller and more local projects of public service are willing to reach out and cooperate with the natural demands of the smaller consumers who are more widely distributed. Naturally the conveniences afforded urban users of electricity, as well as in many farm household operations, will encourage extension of these facilities and conveniences to farm operation, and this is our industry's line of principal interest in the subject.

*An address before the 32nd annual convention of the National Association of Farm Equipment Manufacturers, at Chicago, October 1925. The author, Mr. Zimmerman, is the official representative of the N.A.F.E.M. on the national Committee on the Relation of Electricity to Agriculture.



An electric motor used as power for filling silo

The Committee on the Relation of Electricity to Agriculture is pursuing this subject through the method of developing projects in various parts of the United States, including projects in Alabama, California, Illinois, Kansas, Michigan, Minnesota, Ohio, and Wisconsin. These are in various stages of development. In each of these projects we have common problems, and each will develop special problems which must be solved. As these projects are expected to be under review for several years, we must defer extended or definite conclusions for some time.

Each of these projects in the main involves a well-equipped high-tension power line reaching several miles and connecting with picked farms along the route. These farms are selected to represent typical conditions as to size and possible utilization of electricity. From the power line the local farm lines are served through transformers which bring the voltage down to a safe limit for farm distribution.

Each farm in these projects is being organized with typical electrical equipment and with measuring instruments to furnish mass data for further study.

Another element must also be included in this effort; namely, the individual electric plant with battery support, which now represents a relatively small percentage of the electrical power supply available for farm uses.

We are fully aware of the trend of developments, the superceding of manual labor by mechanical equipment and of animal power by mechanical power; and we are aware, too, of the economics that result from these displacements where they are properly engineered. The rapidity with which modern trends develop into accomplishments need not leave us stranded with unsuitable equipment provided we anticipate them, hence the work of this committee is worthy of our closest attention.

From the farm equipment manufacturer's standpoint we are interested in the possible grouping of these uses so that we may develop our future machinery in cooperation with this movement.

There are three general classifications which prominently divide the field of electrical power application on the farm as follows:

Group 1. (a) Small stationary uses which apply electricity to the lighting of the home, the barns and the yard; (b) applications of electricity for heat, such as the electric iron, the range, the independent glow heater, the water heating units, the toaster, the mangle and the incubator; (c) power applications up to approximately 2 hp. for operating the cream separator, meat grinder, sweeper, sewing machine, light water pumping, electric fans, churn, ventilating fans, washing machine, and home refrigerator.

Group 2. Medium power requirements, both stationary and portable, within a limited range, covering uses that require between 2½ and 5 hp., such as the grain elevator, feed grinder, larger pumping operations, beet cutter operating, fanning mills, the farm shop, small threshers, grain cleaners, corn shellers, dehydrating equipment, milking machinery and concrete mixers.

Group 3. Mobile motor requirements ranging from 5 hp. upward, represented by medium-sized threshers, spraying

(Continued on page 302)

Applying Electricity to Agriculture

By M. H. Aylesworth

Managing Director, National Electric Light Association

IT HAS been said that "A big saint was never made from a little devil." To accomplish big things, things worth while, things which will be constructive achievements, requires big dreaming, big thinking, big planning, and plenty of hard work.

There can be no doubt that rural electrification falls under the classification of big undertakings. Its ultimate benefits, not only to agriculture, but to society as a whole, are just as certain. Once the objective is clearly defined, the next step is a plan of action. Vision is necessary, but to be of service to mankind it must be supplemented by action. For this and other reasons the electric light and power industry is highly elated over the opportunity to join hands with the American Society of Agricultural Engineers in a study of rural electrification. As an industry we can build power stations, design and erect distribution systems, develop rate structures. We take some pride in feeling that we have a firm grasp of the fundamentals of our business.

However, getting the current down to the farm is not rural electric service. It is only one step in that direction. Electricity is of no use unless it is at work. It is revealing no secret to say that the men of our industry are especially concerned over what will be electricity's ultimate place in agriculture. Once this is determined, or at least indicated, we can lay plans in accordance with facts.

It should be obvious to anyone who stops to think that the men in our industry are not agricultural experts, and it should be just as clear that in this taking of electric light and power service to agriculture the missing link at present is on the farm. Therefore, our industry is looking to the agricultural engineer for that knowledge and information which is essential to turning our dream of rural electric service into a reality. We expect the agricultural engineer to furnish the "know how" from the farm end.

We know from experience with other industries that the introduction of electricity as a source of power has brought about changes which even our own people did not foresee in the beginning. We hope that electricity will do even more for agriculture. We hope that it will modernize the farm home, do the chores, plow the fields, plant and harvest the crops. We hope that it will make a new and a better agriculture.

We know that whatever is attempted should be along sound, constructive lines. Lots of good money can be lost chasing schemes which will not bear economic and engineering scrutiny. We are determined that so far as rests within our power the farmer shall not be intentionally nor unintentionally exploited in this proposed development we want. Facts should precede sales efforts.

Last, but by no means least, we believe that the agricultural engineer can and will make available that agricultural-engineering information which ultimately must be the foundation stone upon which any permanent superstructure can be erected.

Therefore, we are must interested in having the agricultural engineers take hold of this problem in an aggressive and a comprehensive manner.

Relation of Electrical Power Development to the Farm Equipment Industry

(Continued from page 301)

operations, ensilage cutting, wood sawing, baling hay, and stationary requirements such as irrigating equipment of some size.

The first group overlaps in some items the small stationary gasoline engine and the individual electric plant. This group is unquestionably well served by electric power machines, with motors directly connected or built in.

The second group, comprising moderate power requirements, undoubtedly should have the careful attention of all manufacturers of farm equipment.

The third group will be only lightly affected by electrical development. The kerosene and gasoline tractor fills the bill much better than any presently possible application of electricity could do, because of the distributing cables for electric motors, the intermittent use of their power and its magnitude during their short periods of use.

Referring again to group 2, we may anticipate here a considerable series of problems of standardization which must be solved in order to coordinate electrical and farm equipment products. The following points are suggested in this classification:

1. A standard series of graded power units and requirements must be established, with a minimum series of common powers, for example, ½, 1, 1½, 2, 3, 5, 7½, 10, 15, and 25 hp., so that there will be unity between the motors and the operated machines.
2. Uniform or standard belt speeds should be set, that is, say, 2,000 feet per minute, and possibly 2,600, 3,000 and 3,500 feet per minute. This would give us a common basis for determining pulley and gear sizes.
3. Standard mountings of motors will be needed to permit the use of various makes of motors on a given machine.
4. Standard heights of shaft centers will be needed to facilitate design.
5. Standard pulley sizes must be agreed upon, with established widths, gear sizes and face widths.
6. Standard safety regulations must be set up to comply with insurance requirements.
7. Standard methods of rating must be agreed upon as to both motors and operated machines.

Some of the above questions of standardization are having careful consideration at the present time and this list will be extended as our study enables us more completely to understand the several problems.

One of the important features for the farm equipment manufacturers to bear in mind is that wherever electric motive power is advisable, the economic rule applies that the desideratum is a minimum amount of power spread over a maximum of time. This is economy from the standpoint of the user because of lower investment in total equipment, and from the standpoint of the supplier because the load factor is better for the station. A new series of smaller sizes of farm machinery would thus be indicated, such machines being operated over longer periods. Examples of such possible operations are feed grinding, grain elevating, pumping, farm shop work, small threshing machines, corn shelling. Here is indicated the desirability of grouping machines and facilities so as to operate on lineshafts, and this consideration may further affect the entire arrangement of farm buildings in order to secure the fullest economy of electrical energy.

From what has been said thus far, it must be evident that we have only started on a complicated problem, which must pass through the stages of adapting present equipment as well as possible and of developing the desirable coordinating optimum equipment as fast as stability factors show themselves. We still are far from being able to determine the extent to which this movement will be sensible, but present indications are that there will be few uses where more than 5 hp. will be called for.

The convenience of the electric motor drive in many cases, with its minimum of attendance as compared with the small

(Continued on page 308)

Some Factors Influencing Flue Velocities in Barn Ventilation*

By M. A. R. Kelley

Mem. A.S.A.E. Associate Agricultural Engineer, U. S. Department of Agriculture

A STUDY of the factors influencing the movement of air through the flues is of primary importance in ventilation research. It is not enough to assume certain flue velocities for a given condition and to base the design of the ventilating system upon this assumption, but rather it is essential to learn what velocities may be expected under a given set of conditions and to design the system accordingly. This involves a study of several variable factors. The general tendency of the effect of these variable factors acting collectively must first be learned. They may then be studied individually in order to learn the conditions under which they produce a dominating effect.

All factors affecting the velocity of air through ventilating flues cannot be discussed within the scope of this paper; moreover there is lacking sufficient knowledge with respect to the proportional effect of some of them. The object of this paper is to discuss some of these factors and to give the results of tests which may aid the exercise of good judgment in designing of ventilating systems to meet local conditions. It is realized that there will be, in individual cases, some departure from the quantitative measures of the different factors, but the data given will serve as guides until further tests and investigation permit of greater refinement in their application.

The principal factors affecting flue velocities are temperature, wind and type of construction. In order to study the effects of temperature we must divide this factor into outside temperature, stable temperature, difference between inside and outside temperatures and the production of heat for maintaining this difference. In the present discussion the heat production is assumed to be constant and ample to produce good ventilation. Since stable temperature is mainly dependent on the heat produced and heat conserved, this phase of the temperature factor will not be discussed. This leaves for consideration outside temperature and temperature difference.

*Paper presented at the 19th annual meeting of the American Society of Agricultural Engineers, at Madison, Wis., June, 1925.

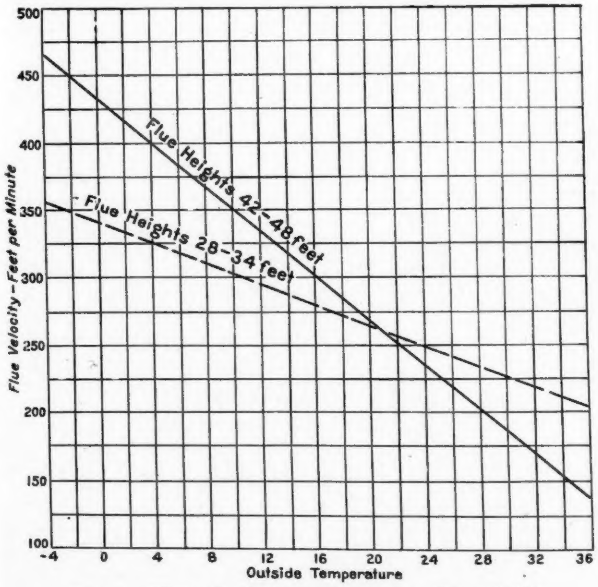


Fig. 1. Effect of outside temperature on flue velocity

Under average conditions, the outside temperature has a closer relationship to flue velocities than does the difference between the inside and outside temperatures.

One purpose of a ventilating system is to provide good circulation of air and at the same time maintain a desirable temperature in the stable. When the outside temperature falls or rises, the system is regulated so as to control the amount of ventilation. These adjustments of the ventilation system due to a change in outside temperature cause a variation in flue velocities, proportionate to the increase or decrease in resistance to air circulation but not necessarily to the change in area of the flue openings because of the leakage which usually exists. The passage of air through the flue is largely dependent, disregarding wind, on the difference in weight of the column of air in the flue and the outside air. The weight of air is determined by the amount of moisture it contains as well as by the temperature and pressure. The lower the temperature the drier and heavier the air. Outside air entering the stable is warmed and absorbs moisture becoming lighter in weight, and therefore has a natural tendency to rise through the outlet flues. There is also a correlation between the wind and outside temperature. It has been observed that there are seldom any effective winds at low temperatures and that as the temperature lowers the wind velocity dies down. There is even a relationship between the wind direction, which affects the velocities in individual flues, and outside temperature.

A study of available data shows that there is a close relationship between temperature difference and flue velocities when the ventilation is unrestricted and unaffected by the wind, but when the ventilation is restricted and other variable factors introduced there may be wide variance in this relationship. The following table of data taken at random from tests will illustrate this point:

Effect of Variable Factors on Flue Velocities

Temperatures—Degrees			Humidity of stable—relative per cent	Flue velocity average f.p.m.	Wind velocity m.p.h.
Stable	Out	Diff.			
56	27.0	29	84	234	16.3
37	8.0	29	81	373	16.7
49	8.0	40	72	288	0.8
45	—13.0	58	78	392	7.0

These data do not represent averages but indicate variations which are by no means exceptional. The strict relationship of the several factors is not shown by such meager data but the facts apparent in the above table suggest an opportunity for further thought. The first two readings were taken when the ventilation was free; the last two when the ventilation system was partially closed. Comparing the first two readings there is an appreciable difference between the flue velocities; the temperature differences are the same, while there is a considerable difference in the outside temperatures. It will be noted that the lower outside temperature is coincident with the higher flue velocity which is in accord with the tendency, shown by existing data, of low outside temperatures to cause higher flue velocities than high outside temperatures with the same temperature difference. In comparing the second and third readings it is found that the outside temperatures are the same; the temperature difference is the greater in the third reading, while the flue velocity is the greater in the second reading, indicating that temperature difference is not the dominating factor. The

greater flue velocity of the second reading is but partially accounted for by the higher wind velocity. The higher stable temperature of the third reading, and the consequent greater temperature difference, was due to the restricted ventilation. Had the system been fully open the temperature difference would have been less while a greater flue velocity would have been expected. This again shows that temperature difference alone does not have a dominating effect on flue velocity.

Studies made under a wide range of conditions show that the adjustment of a ventilation system varies in accordance with the outside temperature, and that wind velocity and stable temperature vary with the outside temperatures. It therefore appears that in actual practice, as studied under a wide range of conditions, the outside temperature bears a significant relationship to the flue velocities, and it is evident that a study of the correlation between outside temperatures and flue velocities is of greater value for practical purposes than a study of the relationship existing between the temperature difference and flue velocity.

In order that practical use may be made of this relationship the accompanying curves have been worked out by the application of the theory of correlation to test data of comparable nature. These curves have been applied to other existing data, in some cases approximately three hundred readings, and it was found that the relationship of the average range of test velocity readings to the curves is so remarkable that it is thought permissible to present them as a tentative guide for estimating flue velocities which may be expected within the range of average conditions of barn ventilation.

It is expected that individual readings of test data may vary from the curve herewith presented, but the general tendency will be to follow it. The straight line is the result of the assumption of a uniform rate of increase or decrease in the variables throughout the range; this is more nearly true when flue velocities are compared on the basis of outside temperature than when compared with temperature differences, since flue velocity varies as the square root of the temperature difference which is incompatible with its representation as a straight line variation.

It will be noticed that the line representing the flue velocities for a flue height of from 42 to 48 feet cross the second line (flue heights of from 28 to 34 feet) at approximately 20 degrees. The cause for this is not apparent but such was found to be the case with the data examined. It is suspected that at temperatures above 20 degrees the effect of variations in flue heights on velocities is not in the same proportion as at low temperatures and that the curve will tend to follow a wide angle at the higher outside temperatures.

Flue Temperatures

A drop in temperature between the bottom and the top of the flue naturally would be expected to have an appreciable effect on the rate of air passage through the flue, but in the data which is the basis of this paper other factors are of such dominating effect that the influence of flue temperatures on velocity is completely hidden. The insulation of flues is necessary in order to prevent or minimize condensation. If flue temperatures do have an effect on flue velocity it will be necessary to provide insulation in order to maintain them. The amount of insulation required can only be determined by further study of flue temperatures and the factors affecting them. The range of flue temperatures recorded in the data referred to was from 1 to 8 degrees. The difference in most instances was from 2 to 4 degrees depending upon atmospheric conditions.

Wind Effects

Although temperature is a major factor in the consideration of the ventilation of farm buildings, wind is also a factor affecting flue velocities under certain conditions. The effect of additional ventilation that an appreciable wind may have on a ventilating system is desirable during warm weather when there is little difference between stable temperature and that of the outside air, but during cold weather it must be guarded against as more than enough ventilation usually can be had without its assistance. Both wind velocity and wind direction have an effect on flue velocities as will be shown later. It is of interest to learn at what velocities the wind appears to be of dominating or little effect.

Wind affects the ventilation of a building in two ways, pressure and suction. When the wind blows against the side of a barn there is developed a pressure which forces the air inward through cracks and openings on the windward side and exhausts it through the opposite side or through the outlet flues. When the wind blows across the top of an open flue or one provided with a ventilator head, a draft is induced within the flue. In this case the movement of air is caused by wind suction. The suctional effect of the wind varies widely and is greatly affected by the design of the ventilator head. In this paper only the plain stationary ventilator—the type most commonly found on barns—is considered.

The accompanying curve from tests made by Prof. Calderwood and others[1] illustrates how wind pressure may act on a ventilator head when temperatures are constant.

Since the ventilators on which these laboratory tests were made were smaller than those usually used in barn ventilation, the quantitative results are not applicable as the wind has relatively greater effect on larger ventilators. The curve is of interest in studying the relationship of the direct effect of the wind on flue velocity, although it is not possible at this time to give a definite measure of the effect of various wind velocities on flue velocities as actually found in practice.

It is natural for the farmer to restrict the amount of ventilation during periods of high wind especially during cool weather; hence, in designing a system the effect of high winds need not be considered in determining the capacity. Tests made under field conditions show that the wind has little effect on the amount of ventilation at velocities below 4 miles per hour and that it is not often a dominate factor until after it exceeds 10 miles per hour. At velocities greater than this the effect is noticeable, but its full effect is seldom obtained in field tests except during warm weather, as the ventilation is generally restricted at the colder periods in proportion to the velocity of the wind. The maintenance of ventilation during periods of calm is of greater importance.

A study of the effect of wind direction is of value because of its relationship to flue velocities and its influence on the location of intakes with respect to corners and adjacent buildings. It is difficult to trace the effect of wind direction on the passage of air through outtakes. The accompanying table and chart show the influence of wind direction on the velocity of air passing through intakes as observed in one test, extending over a continuous period of eight days.

Influence of Wind Direction on the Velocity of Air Passing Through Intakes

Wind direction	Velocity m.p.h.	Intake velocities Windward— f.p.m.	Leeward— f.p.m.
E. NE.	12.2	664	253
N.E.	14.3	460	260
N.	7.0	295	260
N. NW.	10.6	360	296
N.W.	13.1	398	231
	0	296	296

The amounts given in the table and chart are of no significant value as applied to other barns, but they are of interest in that they show the relation of wind direction to the air entering the barn. The table shows that the velocity of the incoming air was the same on both sides of the barn when not influenced by the wind direction. The intake velocity at

[1]Automatic Ventilators—by Calderwood, Mack and Bradley. Jour. Am. Soc. Heating and Ventilating Engineers, July, 1922.

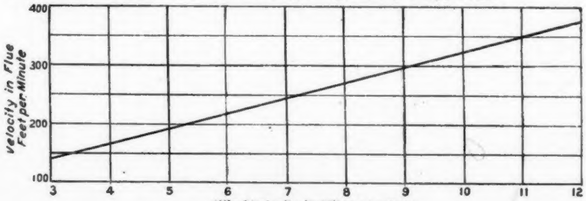


Fig. 2. Average effectiveness of wind on a ventilator

the first reading (664) is probably a little high in comparison with the others as the ventilation system was wide open at the time. The wind was almost directly against the side of the barn at the first and second readings; hence, high intake readings on the windward side would be expected. It will be observed that there was not much variation in the readings on the leeward side. The circular dotted line represents the average intake velocities for the entire test.

Construction Factors

There are many constructive features which affect the design of an efficient ventilating system. Most of these can be controlled and adapted to meet specific conditions. They are no less important than the uncontrollable factors as in many cases they determine the final design of a ventilation system best suited to the local conditions. Neglected consideration of these factors has sometimes caused failure in the operation of the ventilation system.

The location of the barn with respect to adjacent building and windbreaks often materially affects the efficiency of the ventilating system. It is obvious that in a barn located in a pocket formed by higher adjacent buildings or in a valley having poor air change, the air circulation both within and without the barn would be retarded, while if it be located on a hill or in an open space the air circulation would be much greater and perhaps, in some cases, more than is desirable.

After the location of the barn has been determined, consideration must be given to the selection of the ventilator head and the construction and location of the flues, items for careful consideration, as the success of the system is largely dependent upon them.

In selecting a ventilator head to be used on a dairy barn it should be remembered that the ventilation of farm buildings differs from that of factories or commercial buildings. Cold weather ventilation is the major problem on the farm, while in commercial buildings it is generally a warm weather proposition. Air heavily laden with moisture must be removed from the dairy barn, while in most commercial buildings the humidity of the air is of less importance. Some plain stationary ventilator heads are as efficient as the so-called siphon types. The efficiency of the ventilator depends on the design. Many of the common types are more efficient while others are less effective than the open pipe. However, as storm protection is important the use of a well-designed ventilator head at the top of the flue is more desirable than an open pipe. Moreover, in a comparison of several types it appears that a wide storm band intended to prevent the entrance of rain and snow adds to the effectiveness of the ventilator. Closely louvered or slatted openings, such as in the old style wood cupola, are undesirable as they retard the free passage of air from the flues. The throat opening should be of sufficient width to permit free passage of air for the full capacity of the flue. During the winter, frost or icicles form on the ventilators and if the throat opening is small may close it entirely. The formation of ice and snow sometimes affects the operation of rotating ventilators.

The ventilators should be placed on the highest part of the barn and well above the ridge of the roof. If placed at the side of the roof the velocity of air through them often is decreased and a strong wind blowing over the ridge of the roof may cause a down draft in the flue. This backdrafting is more noticeable in some ventilators than in others. The size of the throat opening and the shape of the ventilator should be such as to allow free passage of air when the wind is not blowing and to prevent down drafts when high wind prevails. However, backdrafting in outtake flues may sometimes be caused by too great restriction of the intake openings, which causes an inversion in the function of the outtake. Lack of heat production may also be a contributing cause. Backdrafting in intakes is more often caused by a strong wind or too close proximity to corners of the stable and by eddy currents caused by nearby buildings. The modern type of automatic intakes is designed to obviate this condition.

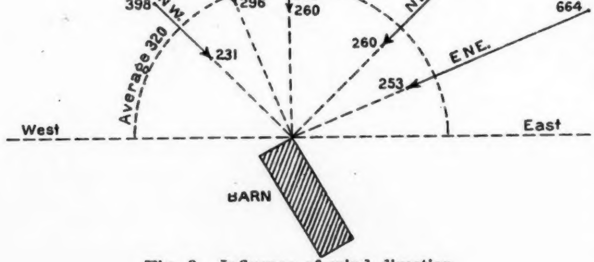


Fig. 3. Influence of wind direction

The construction of the flue may affect the velocity of the air passing through it. The primary purpose of the intake and outtake flues is to provide passageways for easy entrance and exit of air, and they should be placed so as to provide for the greatest distribution and circulation of air within the stable. The height of the flue materially affects the velocity of air passing through it. Theoretically, the higher the flue the greater the velocity. This is true within certain limits but the curves in Fig. 1 indicate that there are certain conditions of temperature under which the flue height ceases to be the controlling factor. This phase of the question is in need of more research study.

Frictional resistance to air passage through the flue is increased by the crookedness of the path which the air has to travel. Flues should be as straight as possible. Horizontal runs should not be used and right-angle turns may decrease the efficiency of the flue more than 50 per cent.

The velocity of air passing through the flues is also affected by their size and shape, the circular flue being more efficient than the rectangular. Comparative values of various shapes differ quite widely. One writer states that the velocity of air through a square flue will be seven-eighths of that through a circular flue of the same area (1 square foot). Another author expresses this in terms which refer to the width and height of flue and gives the equivalent size of circular flue which has been worked out by use of a formula. For example, he gives the capacity of a circular flue 19 inches in diameter as equivalent to a rectangular flue of 15 by 20 inches. Assuming these flues to be made of the same material, there would be in this case a saving of about 15 per cent of material in using the circular form.

The necessity of properly insulating both intake and outtake flues is often overlooked. The flues should be air-tight and free from cracks as these greatly decrease the efficiency. Instances have been observed in which the last 8 or 10 feet of outlet flues, and in some cases the entire length, were without any insulation. This is poor practice which decreases the capacity of the flue and may have other undesirable effects such as the causing of condensation.

It appears then that in actual practice the outside temperatures bear a closer relationship to flue velocities than do temperature differences; that the relationship of temperature differences to flue velocities is quite apparent under unrestricted ventilation, but that this relationship is often subject to wide variations by adjustment of the ventilator system and variation in wind velocities; that the wind has little effect at velocities below 4 miles per hour and seldom becomes dominant until the velocity is above 10 miles per hour; and that flue velocities may be greatly retarded by improper flue construction and poorly designed ventilators. Some of these factors cannot be controlled while the effects of others may be utilized or guarded against by the careful designer. It is hoped that this paper will induce greater discrimination and exercise of good judgment on the part of designers resulting in greater efficiency in ventilating systems.

* * *

The American Society of Agricultural Engineers, through the activities of its Committee on Farm Building Ventilation, has to its credit some outstanding progress along farm building ventilation lines. Such men as Kelley (author of the foregoing paper), Clarkson, Whitnah and others have made contributions to the science of farm building ventilation that are of the most far-reaching importance.—Editor.

A New Idea in Drainage for the Irrigation Farmer*

By James C. Marr

Irrigation Engineer, U. S. Department of Agriculture

THOUGH rapid steps have been made in the development of methods, equipment, and organization for handling land drainage work, the reclamation of extensive areas of waterlogged land await cheaper means of accomplishing drainage. What is most needed is some improved means by which the farmer, or a small group of farmers, may provide the needed drainage facilities through the expenditure of their own time and energy rather than by an outlay of capital.

Such a method has been developed by the American irrigation farmer. It is known as "sluicing," or the "hydraulic method." The principle involved is similar to that employed in connection with hydraulic mining and also with the hydraulic method of constructing earthen dams, or the displacement and conveyance of earthen materials by a rapidly moving stream of water.

Occasionally the idea may also be utilized to advantage in cutting channels through materials which are too soft to withstand the weight of heavy excavating machines.

Requirements. As may be readily imagined, the idea as applied to drainage construction is limited to a somewhat restricted field of usefulness due to the fact that a number of favorable conditions must be found first to obtain, before successful operation of the scheme could be hoped for. Briefly, the necessary requirements are that water for sluicing be available in large quantities, at a low cost, and favorable locations; that the grade or slope of land along the line of location of the drainage ditch be somewhat greater than is usually available where drainage is necessary; and, lastly, that the soil to be excavated be susceptible of being transported by water.

Drainage by the Sluicing Method. It is not known how frequently these conditions might be encountered, and it is altogether possible that this scheme might not be applicable at all to drainage conditions in humid sections, but it has at least found a place of usefulness in more than one instance in connection with one irrigated section, and it is certain that similar conditions will be found in other irrigated localities.

Drainage systems constructed by the sluicing method and observed by the writer are located in the Valley of the Malheur River in eastern Oregon in what is known as the Warmspring District. They may be described as having a depth of from four to twelve feet, averaging about five feet in width, varying in length from one-fourth to four miles, and having a grade of from eight to sixteen feet per mile. In one instance the banks have been trimmed to a slope of approximately 1 : 1, but in all other cases the side walls are vertical. The excavated material has in all cases been entirely disposed of by the water, thus eliminating the unsightly feature of irregular piles of earth resulting from the usual open ditch construction.

Method of Construction. As nearly as can be learned at this time through inquiry and personal observation these ditches have been constructed through the use of a stream of water varying from 5 to 7½ cubic feet per second, which has been available from irrigation canals located on lands higher than those requiring drainage. The proposed ditch line is prepared to receive a stream of water in the usual manner of making an ordinary small irrigation ditch, i.e., by first plowing and then removing the loosened material by means of a "V," which as actually used in this work consists of a heavy, adjustable, metal, V-shaped implement known as a metal ditcher (Fig. 1). When the stream of water has been successfully diverted to and along the line of the proposed ditch an implement, called the "purvis," is employed to loosen and pulverize the soil and cause it to be held in suspension and carried away by the water.

This implement is fastened by a chain or cable to the middle point of a long, stout pole which spans the ditch and forms the means by which the purvis is pulled up and down the ditch. The motive power employed for this purpose is two teams of horses, two animals being hitched to either end of the pole. When it is desired to reverse directions, the teams are wheeled about and made to pull in the opposite direction, the purvis being turned over in this operation. The method of manipulating the purvis is illustrated in Fig. 2, showing where it has fallen flat into the ditch and is ready to be dragged down stream. These implements may be operated in gangs of any number and such practice seems to give better results than where the single outfit is used. It will be noted that in Fig. 2 two implements are being operated together. Two men are required to operate each purvis.

Where loose soil similar to volcanic ash or sandy loam is encountered the purvis is the only implement required to complete a vertical walled ditch, but in cases where a tougher material is found, as would be the case with clay or adobe, a heavy road plow is added to the equipment. This is rigged up in the same manner as the purvis, but, depending upon the material to be loosened, more power may be required to operate it. Fig. 3 shows a plow being used for this purpose wnere six horses are employed. Two drivers and one plowman are required to operate the plow for this purpose.

Construction work on these ditches is usually started at the lower or outlet end and the entire depth is excavated by sections of a few hundred feet. Thus a maximum fall is always available at the point where work is being done, which, of course, aids in cutting the channel and in mixing the soil with the stream of water. This effect of grade on the velocity of the water, and hence its erosive and carrying capacity, is materially augmented through the operation of the purvis, or a gang of these implements, since they have the effect of making the water surge ahead.

As might be expected, gravel cannot be moved by this method; however, where small beds of this material are encountered the use of the sluicing method of excavation is not precluded, nor is the progress of the work greatly re-

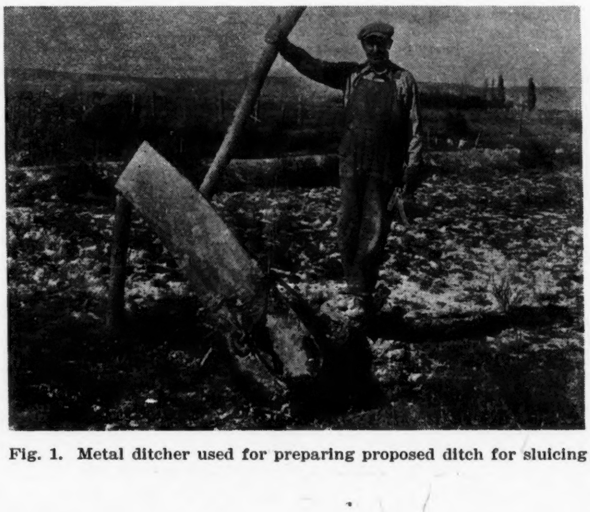


Fig. 1. Metal ditcher used for preparing proposed ditch for sluicing

*One section of the 1924 report of the Committee on Drainage of Irrigated Lands of the American Society of Agricultural Engineers.

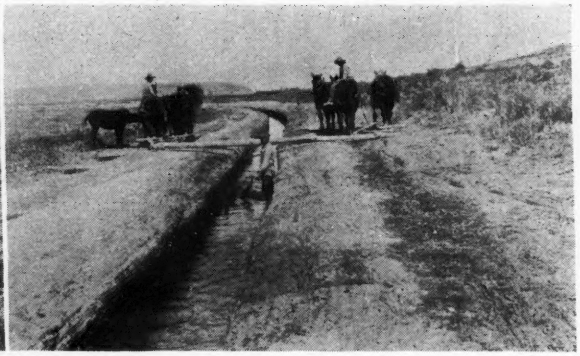


Fig. 2. (Left) This shows the method of using the purvis. Fig. 3. (Right) This shows how a heavy road plow is used to loosen up clay or adobe previous to sluicing with a purvis

tarded. The ditch immediately below the gravel bar, and in some cases above it, is excavated to a sufficient depth to permit the dragging of the heavier material into the pit so formed. Where beds of gravel, or other materials which cannot be easily transported by water, form any considerable part of the material to be removed, the sluicing method should not be considered as a feasible plan for doing the work.

As before stated, the banks of the canals that have been constructed by this method are in all but one instance vertical. In the case of this one exception, that of the O. E. Carman ditch, the banks were sloped by hand with long-handled spades. This task could, of course, be simplified materially by the use of a properly designed implement. In a number of cases where ditch banks have been left vertical caving has set in to such an extent as to stop the flow of water. This result is shown in Figs. 4 and 5. The former shows a section of ditch shortly after it was constructed, while the latter was taken from the same point one year later. Undoubtedly it would be desirable to give the banks the ordinary side slope.

Equipment. As has been previously stated a steel ditcher, a road plow, and one or more purvises, together with horse power and man power, are sufficient to put the sluicing method of excavating a drainage ditch into operation.

Of this equipment, the purvis alone need be described. This implement was designed and built by Purcy Purvis, Vale, Oregon, to be used especially for the work described in this article. The purvis is in reality a cylindrical harrow. Five heavy iron hoops about eighteen inches in diameter, each studded with steel knives or point and held in a vertical position about twelve inches apart by several heavy longitudinal iron straps, form the implement. The longitudinal straps terminate at one end in a blunt point to which is secured a ring by which the purvis is drawn. Threshing machine drum knives are used for the blades which protrude from the five iron hoops. In Fig. 4 one of these implements may be seen on the bank of a drainage ditch which was constructed by the sluicing method.

The only accurate figures available on the cost of construction and maintenance for such drainage systems is that furnished by O. E. Carman, Vale, Oregon. Mr. Carman's statement relative to his ditch follows:

"My ditch is 2,226 feet long and averages about 12½ feet in depth, 10 feet across at the top and about 3 feet on the bottom, and was made at a cost of $232.00. We figured man and team at $5.00 per day. When we had put the ditch down to the right depth we sloped the banks with a long-handled spade. The cost of sloping the banks was figured in with the $232.00. I do not think our cost of upkeep on this ditch will exceed $10.00 per year. This ditch at the heaviest period of the irrigation season carries off over 100 inches (minor's) of drainage water. In sluicing this ditch, we at no time had over 250 minor's inches of water and during most of the time used less than 200 inches. The fall was probably around eight feet.

In connection with other drainage work in that section Mr. Carman has the following to say:

"There are about a dozen individual farmers at work or planning to use this method of making ditches here in the Warmsprings District this winter. It is not only a very cheap way to make drains, but is a method that the farmer can use and be out little or no cash in constructing his drains. In the case of the ditch that went into my land where three landowners were interested, we could never have gotten together as to what each should pay had we been obliged to put in a costly ditch by the old method so would have been forced into a drainage district in which the attorney's fee alone for the formation of the district would have exceeded the whole cost of our present ditch."

* * *

The idea described here for the solution of an important drainage problem in irrigated areas fully merits the space that has been given it. It is a typical example of what can be done to increase efficiency and to decrease costs in applying engineering knowledge and skill to the problems in agriculture. —Editor.

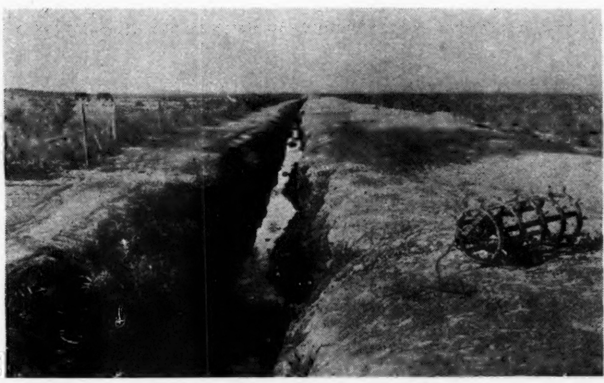


Fig. 4 (Left) This shows how ditch banks left vertical have caved in shortly after sluicing. (Note the "purvis" in the foreground.) Fig. 5. (Right) A view of the same section of ditch one year later

A Thresher for Single Heads of Grain

(Continued from page 297)

motor shaft) and long axis 4½ inches, gave satisfactory results with all ordinary varieties of heads both of wheat and of barley.

A block of hard wood 3½ by 4 by 5 inches served to lift the motor a sufficient distance above its base and to furnish adequate support for the heavy sheet-metal housing. For greater stability a wooden sub-base 2 by 12 by 18 inches was added, though it was not absolutely necessary.

All commercial manufacturing rights in this machine are reserved for the University of California. However, on request, permission may be granted to experiment stations to copy it for their own use. Blue prints will be furnished on request sent to the Agricultural Engineering Division, Branch College of Agriculture, Davis, Calif.

SPECIFICATIONS

Height over all (excluding 2-inch sub-base, not shown), 19½ inches; weight, including motor, 38 pounds.

Cylinder: Tooth-tip circle, diameter 6⅝ inches; clearance, 3/16 inch radial.

Barrel: 2¼ inch o.d.; 1¾ inch i.d.; length 2⅞ inches; cover plate, 1/32 inch thick, peined in.

Teeth: No. 30; rows, 6; diam. ¼ inch; length above barrel 2 1/16 inches; screw thread ¼ inch S.A.E.; fastening, external jamb nuts; tips casehardened and ground to true tip circle.

Housing proper: Diam. outside, 7⅛ inches; length outside, 3⅛ inches; thickness of wall 1/16 inch.

Feed chute: Height above housing, 5¼ inches; size top, 3⅝ by 4½ inches oval; throat, 2¾ inch parallel to shaft by 2¼ inches.

Grain box: Outside, 2⅛ by 3 by 4½ inches. Inside, curved false bottom smoothly soldered in.

Air blast inlet: Semicircular, 3¾ inch diam. (below center-line of shaft).

Motor: 220-volt, about 1/12 hp., commutator type for alternating or direct current with six-step rheostat for speed control. To be used generally on 110 volts alternating current, but also on 220 volts alternating current when extra torque and speed are needed for extraordinary tough material.

Relation of Electrical Power Development to the Farm Equipment Industry

(Continued from page 302)

gasoline engines, is counter balanced by relatively higher operating costs. Line loss of from 30 to 50 per cent of the station input is one of the drawbacks.

The power companies still have divided opinions as to whether single-phase or three-phase motors shall be used for farm installations. Studies of the projects heretofore referred to will aid in this determination as well as the desirable line voltages.

The question of fair rates is an intricate study for the power companies. We find many schemes being tried to adjust equitably the expense of distribution, maintainance, depreciation, ratios of power costs per kilowatts used, etc.

The farm equipment manufacturers will likewise have his series of problems in revamping his products to fit electrical power. The outstanding problem will be that of determining efficiencies and minimum power requirements of various equipment as was done with ensilage cutters at the University of Wisconsin. Such researches are valuable no matter what may be the outcome of this series of experimental electrical projects. We should also consider completely modern standards of design in friction-reducing bearing, better lubrication systems and materials. These factors along with the basic idea is not a large element, will render farm equipment more satisfactory, whether it be driven by electric or internal-combustion power.

There are many problems indicated in the review of the applications of electricity to agriculture which may develop into considerable prominence, such as the effects of electricity on crop production and crop curing. In such cases as have been crudely developed under high costs the results are such as to indicate a policy of watchfulness on the part of our industry and of readiness to cooperate in experimental research, so that it may rapidly take advantage of electrical progress and produce equipment to keep pace with it.

How Drainage Paid One New Jersey Farmer

BY E. R. GROSS

Agricultural Engineer, Rutgers University

EVERY agricultural engineer knows there is a vast acreage of land that would produce more if drained, so that the crops might be put in early in the season and be ready for market a week or two earlier, also that reaching the market only a few days earlier would often double the returns for early vegetable crops.

This fact was discovered by a farmer near Lyndhurst, New Jersey. His ideal location with reference to markets in New York City made him each year chafe at the thought that his vegetable gardening lands were cold and wet. The local county agent and the agricultural engineer at the state agricultural college were consulted and asked to look over the ground. In this survey the farmer asked many questions, such as "Will it pay to put tile in this soil?" "How far apart must they be placed?" "What slope must be used?" and "What shall be the arrangement of main and laterals?"

All these points were worked out by the agricultural engineer and a sketch of the proposed little system was left with the farmer. One year later the owner said the tile had been paid for by the added returns from an earlier and better crop of vegetables.

This area reclaimed is small but it is used for intensive cropping. The tile was installed with this in view. Tile spaced every 50 or 75 feet might furnish sufficient drainage for an ordinary field crop, but the agricultural engineer insisted on a spacing of 20 to 25 feet. For an early vegetable crop the water must be taken away very quickly so the soil may become warm and mellow more rapidly.

American Engineering Council

THE meeting of the Executive Committee and the Administrative Board of American Engineering Council, which will be held in connection with the annual meeting of the Council, will be held in Washington, Wednesday, January 13, 1926. The assembly of the Council will hold its annual meeting on January 14 and 15.

Research in Agricultural Engineering

A department conducted by the Research Committee of the American Society of Agricultural Engineers

Some Practical Research in Concrete Drain Tile

SIXTY stout crates, each containing fifty concrete cylinders, each of which were two inches in diameter by four inches in length, were raised from the bed of Medicine Lake in eastern South Dakota recently by S. H. McCrory, chief of the agricultural engineering division of the Department of Agriculture; E. V. Willard, commissioner of the Minnesota state department of drainage and waters, and D. G. Miller, drainage engineer in charge of the drain tile laboratory of the University of Minnesota. Every cylinder was closely examined by the men, and all but five hundred were again placed in the lake.

The three thousand specimens represented about one hundred and twenty-five different types of concrete, all made up at University Farm, St. Paul, Minn., for the purpose of perfecting a concrete drain tile that will endure in certain alkaline soils common to western Minnesota and the Dakotas. Each cylinder bore a number so that by reference to the corresponding number in the files kept at University Farm, information as to the quantity and quality of cement, the kind of sand, the amount of water, etc., used in making it can be found readily. Certain types of these specimens showed pronounced deterioration, while others were apparently as sound and strong as when placed in the lake. It is from the study of these that it is hoped to produce a concrete tile that can resist indefinitely the action of alkaline salts. Best results are being obtained with specimens made of cement concrete specially treated and with specimens in which special cements have been used.

Medicine Lake lies seventeen miles northwest of Watertown, South Dakota, and about six miles south of Florence. Long ago it got its name from the large percentage of sulphate salts that its waters contain. It is fed by alkali springs rich in Epsom and Glauber's salts.

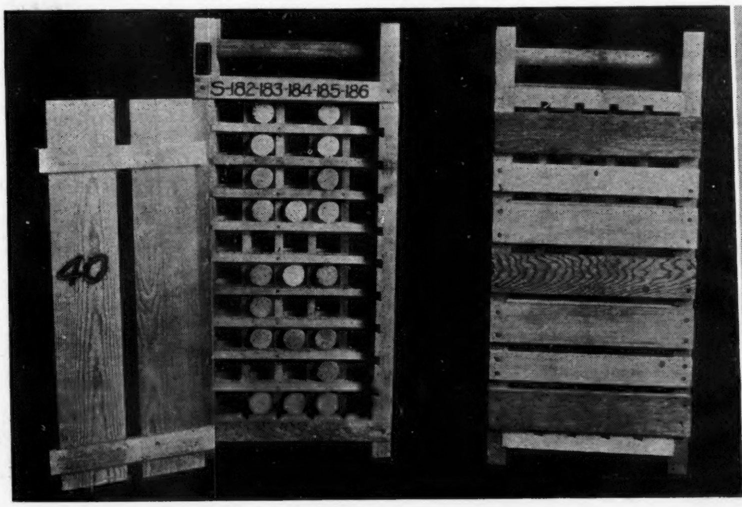
Other concrete cylinders, after being immersed at University Farm for more than three continuous years in an artificial solution, similar in character to the constituents of the salty lake, show no deterioration. These investigations, as well as those at the lake, will be continued until a tile mixture is found that will stand up under any and all conditions, if that be possible, according to Mr. Miller, in charge of the laboratory.

Specimens of concrete tile are also being tried out in the peat lands of Minnesota. Tests in peat are now being made at Coon Creek, Grand Rapids, and Karlstad. It is hoped that eventually this problem will also be solved.

The drain tile laboratory at University Farm was established July 1, 1921, under a cooperation agreement of the department of agriculture of the University of Minnesota, the department of drainage and waters of the State of Minnesota, and the U. S. Department of Agriculture. The direct purpose is to study the effect of so-called alkali waters on tile made of Portland cement concrete and to produce tile that will have definite resistance and endurance. This work is of special interest to landowners of southwestern and western Minnesota, where tile failures in public ditches, resulting from alkali, were first noticed early in 1919, and which have continued to develop up to the present season in ditches constructed a few years ago. The results of this work also have far-reaching application to many other sections of the United States where tile drainage is a factor in agricultural development.

Perhaps the most tangible evidence of what already has been accomplished by this work has been the fact, that, so far as known, no failures due to disintegration have occurred in any public ditch in Minnesota in which tests or examinations were made, before construction, by the laboratory operators. This is due, Mr. Miller says, to the cooperation of the manufacturers in improving the quality of tile, and the readiness of engineers in availing themselves of the opportunities to make tests and soil water examinations as a part of the preliminary survey, thus making it possible to specify and obtain in advance the kind of tile to be used.

Combined with research, service work is performed in the laboratory by testing tile for engineers, manufacturers, and individuals, and by examining for alkali the soil waters submitted by engineers, in which the use of drain tile is contemplated, in order that proper materials may be specified. This service work assures a high quality of tile for use in both public and private ditches of Minnesota. In the public ditches alone more than 7,000 miles of tile have already cost more than $10,000,000.



(Above) Left to right, samples of concrete tile that have lain in peat soil, in clay soil, and been in the stock pile for 11 years. Specimens were made at the same time and from the same materials. (Right) Front and backviews of crates used to test drain-tile materials in alkaline waters. Sixty of these crates, each containing fifty specimen cylinders of concrete, have been immersed in the waters of Medicine Lake, South Dakota.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture

Percentage of Water Freezable in Soils, A. M. Wintermyer (U. S. Department Agriculture Public Roads, 5 (1925), No. 12, pp. 5-8, figs. 2).—Experiments are reported which showed that when water contained in a soil is frozen such freezing very seldom involves all of the water of the soil. When frozen in a dilatometer the water content can be divided into three volumes determined by the temperature at which they are frozen. The first volume, which will be frozen at O degrees C., is classified as free water; the second, which will freeze at from —4 degrees to —78 degrees, is classified as capillary or adsorbed water; and the third, classified as combined water, is so intimately associated with the soil that it can not be frozen at temperatures below —78 degrees. Different soils varied widely in the percentage of their contained water which fall into these three classes.

Studies of the properties of the soil which affect the percentage of the contained water that may be frozen showed that as a rule the condition of the moisture and the temperature at which it will be frozen depend upon the physical, chemical, and mineralogical composition of the soil. Soluble salts, organic matter, and colloidal material present will remove a certain percentage of the moisture from the free state and prevent its freezing.

The mechanical analysis does not indicate the freezing percentage since it merely shows the size of the soil particles, and the unfrozen water is an index not only of the size of the particles but of other properties as well.

Agricultural Engineering [Studies at the Missouri Station], J. C. Wooley and M. M. Jones (Missouri Station Bulletin 228 (1925), pp. 29, 30, figs. 2).—Progress results of a study of methods of prolonging the service of wood fence posts (Agr. Engin., 4 (1923), p. 161) show that setting in gravel and charring did not pay, while painting with hot carbolineum was perhaps better than painting with creosote. Double tank treatment with creosote was the most effective treatment, the 5-hour treatment being better than the 2-hour. It did not pay to treat some varieties, particularly honey locust, willow, cottonwood, and white oak, unless the whole post was treated. Black ash, sassafras, red oak, and ironwood made good posts if given the double tank creosote treatment.

Progress results of the study of the draft of wagons showed that high wheels reduced the draft on all the roadways tested, the amounts ranging from 9 per cent on good hard-surfaced roads to 36 per cent on roads with chuck holes and on roads with a firm base but with loose material on top. Wide tires reduced the draft on all the roadways tested except those with a firm base but with loose material on top. The greatest reduction was 20 per cent on corn stubble.

Data on the cost of electricity from 32-volt farm light plants are also included.

Minimum Live Loads Allowable for Use in Design of Buildings (U. S. Department of Commercial Bureau of Standards, Elimination of Waste Ser., pp. VI+38, fig. 1).—This is the report of the Building Code Committee, presented November 1, 1924, which is divided into three parts. Part 1 explains briefly the organization of the committee and its activities; part 2 recommends minimum live loads allowable for use in the design of buildings; and part 3 is a compilation of live load data and of material not suited for incorporation in a building law, but which is explanatory of the requirements recommended in part 2 and descriptive of good practice.

Rules for the Construction, Operation and Maintenance of Electric Transmission Lines of 6,600 Volts and Less, Between Line Conductors (Des Moines: State, 1922, pp. 32, figs. 8).—The text of these rules applicable to the State of Iowa is presented. Data and information are included which should be of importance in connection with studies of the application of electricity to agriculture in the state.

Heat Transmission of Insulating Materials (New York: American Society Refrigerating Engineers, 1924, pp. III+114, figs. 50.)—This report of the insulation committee of the American Society of Refrigerating Engineers was presented at the annual meeting in 1922, and has been revised to 1924. The following articles are contained therein.

The Principles of Heat Transfer, by H. C. Dickinson; Definitions, Nomenclature, and Symbols, by E. F. Mueller; Surface Transfer of Heat, by T. S. Taylor; The Measurement of Temperature, by P. Nicholls; The Plate Method of Testing Insulating Materials, by M. S. Van Dusen; The Box Method for Determining Heat Transmission, by A. J. Wood; The Economic Value of Insulation, by J. H. Stone; Results of Tests to Determine Heat Conductivity of Various Insulating Materials, by C. H. Herter; and Problems, by H. Harrison. An extensive bibliography, compiled by C. H. Herter et al., is also included.

An Electric Sterilizer for the Average-Sized Dairy (Journal of Electricity, 54 (1925), No. 9, p. 323, figs. 2).—This apparatus is described and illustrated, and data on its operation are briefly presented. It consists of a 30-gallon boiler placed over a heating chamber containing a 5 kw. hairpin heating element. A sheet metal sterilizing chamber, large enough to hold four 10 gallon cans, is placed adjacent to the boiler. Live steam may be generated at any desired pressure up to 75 pounds, at which point a safety valve is set to operate.

American Society of Heating and Ventilating Engineers Guide, 1924-25 (New York: American Society Heating and Ventilating Engineers, 1924, [3. ed.], pp. [6]+458+52, [pl. 1], figs. [85]).—This is the third edition of this handbook, containing the usual technical and commercial data.

[Agricultural Engineering Studies at the Indiana Station] (Indiana Station Report 1924, pp. 36-39, figs 3).—Tests of binder twine showed that the average tensile strength for most brands tested was above the guaranty, but that the lack of uniformity in both tensile strength and thickness of the twine was the cause of breaks. It was found that the tensile strength of binder twine is directly proportional to the number of fibers in it, and that the number of fibers is of greater importance than their length. It was further found that the thickness of binder twine is not always an indication of its strength, since loosely twisted twine allows fibers to slip, causing the stress to be carried by individual fibers.

Studies of the requirements for apple storage showed that with no means of mechanical refrigeration or heating available, the temperatures inside an apple storage house tended to follow prolonged outside conditions. The humidity within the storage rooms was easily maintained at approximately 90 per cent saturation, with 80 per cent as a minimum, regardless of outside changes. Temperatures could be reduced by natural draft to as low a degree as by forced ventilation, but not so quickly.

Experiments with a home lighting plant propelled by wind showed that this outfit had a capacity to produce an average daily output of 97.2 ampere-hours, or enough electricity to light the average farm home and also operate such appliances as a sewing machine or vacuum cleaner.

United States Government Master Specification for Asphalt for Mineral-Surfaced Roofing (U. S. Department of Commerce, Bureau of Standards Circular 159 (1924), pp. 10, fig. 3).—The text of the specification is given.

United States Government Master Specification for Coal-Tar Pitch for Water-Proofing and Damp Proofing (U. S. Department of Commerce, Bureau of Standards Circular 155 (1924), pp. 11, figs. 3).—The text of the specification is given.

United States Government Master Specification for Asphalt Primer for Roofing and Waterproofing (U. S. Department of Commerce, Bureau of Standards Circular 162 (1924), pp. 7, figs. 2).—The text of the specification is given.

Removal of Floating Dust in Grain Elevators (Chicago: National Safety Council, 1924, pp. 32, figs. 12).—Studies to determine the essential factors involved in the application of suction to belt loaders, belt discharge pulleys, elevator boots and heads, garners, and similar items of grain handling equipment, so as to minimize the escape of floating dust into the atmosphere of the plant without picking up an appreciable percentage of solid grain, are reported.

It was found that the average velocity of air entering a dust collecting hood must not be greater than 500 feet per minute in order that solid grain may not be picked up. A velocity of 500 feet per minute will control the floating dust. The results of the boot, head, garner, and belt tests showed that for a velocity much in excess of 500 feet per minute, small quantities of solid grain were found in the traps. Lowering the boot connection velocity from 732 to 630 feet per minute greatly reduced the solid grain picked up. Lowering the head connection velocity from 587 to 468 feet per minute had a similar effect. The belt hood tests showed a good control of the floating dust with an intake velocity of 537 feet per minute. The floating dust was effectively controlled in all tests.

It was further found that the average velocity of air in pipe lines must be at least 4,000 feet per minute in order to prevent clogging of the lines due to the settling out of any materials likely to enter the system. This is considered to be especially important in view of the frequent and usual connection of floor sweeps and dust hoods to the same trunk line piping.

A definite relation was found to exist between hood intake velocity and pipe line velocity and, in the usual type of installation, is a matter of ratio of hood intake area to pipe area. Any pipe line velocity in excess of 4,000 feet per minute may be employed, provided the hood area is large enough to limit the intake velocity to 500 feet per minute.

Inspection troops may be readily constructed and installed in the branch pipe lines in convenient places so as to prove at any time whether or not solid grain is being carried through the line.

Descriptions of the theory and apparatus involved in these studies are appended.

A. S. A. E. and Allied Activities

The Better Farm Homes Conference

EXCELLENT progress is being made by the Farm Structures Division of the American Society of Agricultural Engineers in organizing the "Better Farm Homes Conference" to be held in Chicago in January or February next. The program is rapidly taking form and promises to be of outstanding interest not only to agricultural engineers but also to farm men and women, manufacturers of farm home equipment, and all organizations in my way interested in or active in the better farm homes movement.

Plans for the conference in general, including the building of the program, are under the personal direction of Deane G. Carter, of the University of Arkansas, Fayetteville, chairman of the Farm Structures Division. A. J. R. Curtis, of the Portland Cement Association, Chicago, will have charge of local arrangements for the conference.

While the conference will be under the auspices of the Farm Structures Division of the Society, and the arrangement for the program will be in the hands of that organization, all organizations in any way interested in the better farm home movement, will not only be asked to send representatives to attend the conference, but also to take part in the program, as it is planned that each organization shall be given an opportunity to present to the conference a brief report of its activities on behalf of better farm homes. In this way it is anticipated that a real effort will be inaugurated to bring about a better general understanding of what various agencies are doing to promote a higher standard of living on the farm, and to coordinate these activities in so far as possible or desirable, in order that the maximum desired effect may be attained.

The program that has been tentatively outlined calls for a two-day session. The first day's program will be devoted to papers and reports of general interest and devoted to various important phases of better farm homes.

The evening session of the first day will be featured by a dinner and get-together with a short program which will include one or more important talks on subjects related to better farm homes, for which arrangements will in all probability be made for the broadcasting of these addresses.

At the forenoon session of the second day will be featured short talks from representatives attending the conference from various organizations interested in better farm homes.

The afternoon session of the second day will be devoted largely to committee reports, which will include reports of committees of the American Society of Agricultural Engineers relating to better farm homes and a report of a special advisory committee consisting of representatives of A.S.A.E. and other organizations appointed for the purpose of formulating a program for subsequent conference of a similar nature.

Inasmuch as the program is still in the making, suggestions from those interested will be welcomed by those having charge of arrangements for the conference. Suggestions of subjects for discussion at the conference should be addressed to the Secretary of the Society, or to D. G. Carter, chairman of the Farm Structures Division, Fayetteville, Arkansas.

Pacific Coast Section Meeting

THE Pacific Coast Section of the American Society of Agricultural Engineers, according to announcement made by L. J. Fletcher, Davis, California, secretary of the section, will hold a meeting at University Farm, Davis, California, on December 18. This is the usual winter meeting of that section.

The feature of this meeting will be a paper by Major O. V. P. Stout, chairman of the Reclamation Division of the Society, entitled "The Field of A.S.A.E. in Reclamation." Invitations have been issued to the Sacramento and San Francisco divisions of the American Society of Civil Engineers to attend this meeting and take part in the discussions on the various subjects pertaining particularly to reclamation. As stated in the announcement by the secretary of the section, it is hoped at that meeting to arrive at a policy as to the proper function or fields of activity of A.S.A.E. and A.S.C.E. in connection with reclamation, a policy that will be agreeable to both societies and that will provide for the proper coordination of the efforts of each and prevent duplication of effort. It is not anticipated that there will be any particular difficulty in agreeing up such a policy inasmuch as the interests of the two organizations, as well as the their logical fields of activity, are pretty well defined with practically no overlapping.

At this meeting also considerable time will be devoted to a discussion of plans for the annual meeting of the Society to be held at Lake Tahoe, California, June 23, 24, 25, and 26, 1926. Also plans will be discussed and formulated for a large increase in the membership of the Society on the Pacific Coast.

Purdue Adopts Term "Agricultural Engineering"

AT PURDUE University action was taken recently in which the term "agricultural engineering" was adopted as standard in all divisions including teaching, research and extension. Formerly the term "farm mechanics" was used in connection with teaching work and the term "rural engineering" was used for the experiment station and extension work.

It is gratifying to know that Purdue has stepped in line with practically 90 per cent of the other land-grant colleges and experiment stations, including the federal department of agriculture, in accepting the term "agricultural engineering" as standard for all work of engineering grade.

The American Society of Agricultural Engineers at its annual meeting at Madison, Wisconsin, in June passed a resolution urging that the term "agricultural engineering" should be applied to agricultural work of college grade and the commercial and research work of a strictly engineering nature, and the Society is making a special effort to encourage the universal adoption of this term wherever work of engineering grade is referred to.

News of A.S.A.E. Members

D. W. Bloodgood, associated irrigation engineer, U. S. Department of Agriculture, is joint author with A. S. Curry, assistant irrigation engineer of New Mexico College of Agriculture, of Bulletin No. 149 "Net Requirements for Crops for Irrigation Water in the Mesilla Valley, New Mexico." It is issued by the New Mexico Agricultural Experiment Station. The bulletin is based on investigations carried on under cooperative agreement between the U.S.D.A. Division of Agricultural Engineering and the New Mexico Agricultural Experiment Station.

Orve K. Hedden, 1925 graduate in agricultural engineering at the University of Nebraska, is assistant professor in charge of farm mechanics in the department of agronomy of the Colorado Agricultural College.

C. C. Hermann and three other associates have organized Hermann Associates, Inc., which has for its purpose the conduct of a general mechanical, automotive, industrial, and agricultural-engineering business with respect to consultation, arbitration, professional advice, valuation and appraisal, service and efficiency tests, reports, investigations, research, supervisory and management of engineering projects. The capital stock of the new corporation is $250,000.00 and their

headquarters are located at 610 Best Building, Rock Island, Illinois.

A. H. Hoffman and H. L. Belton, division of agricultural engineering, University of California, are authors of Bulletin No. 391, "Machines for Coating Seed Wheat with Copper Carbonate Dust," just issued by the University of California printing office.

F. D. Jones, a 1925 graduate of the University of Wisconsin, was recently appointed to the position of instructor in agricultural engineering at the University of Tennessee.

E. Grant Lantz, of the department of farm machinery at the Pennsylvania State College, is temporarily attached to the bureau of fire protection of the Pennsylvania State Police. Recently he made an analytical and critical study of available technical information on the fundamental causes for different fires and was able with this information to show why such fires occur and how they may be prevented. The report of his investigation is a very fine piece of research work of a highly important character.

E. R. Raney has resigned as extension farm engineer of the North Carolina Department of Agriculture and State College, to become associate professor of agricultural engineering at the A. & M. College, of Texas.

J. MacGregor Smith, professor of agricultural engineering, University of Alberta, is author of a new bulletin just issued by that institution entitled "Binder and Knotter Troubles," being a well illustrated, very thorough treatise of that subject.

E. R. Wiggins has accepted a position as associate editor of "Farming," an agricultural magazine published at Knoxville, Tennessee. He will devote his attention largely to the development of the agricultural engineering features of the publication and will establish headquarters at 1126 14th Avenue, Moline, Illinois.

New A.S.A.E. Members

R. C. Agrawal, lecturer in mechanical engineering, Government Agricultural School, Bulandshahr, U.P., India.

Charles Allen Bacon, manager, research and educational department, Oliver Chilled Plow Works, South Bend, Indiana.

Lucas Smith Caple, rural service engineer, Rochester Gas & Electric Corporation, Rochester, New York.

Curtis I. Cohee, Jr., director, quality control department, Philadelphia Inter-State Dairy Council, Pennsylvania.

Elmer William Hamilton, Clarke Publishing Company, Madison, Wisconsin.

Allen Crosby Hardison, civil engineer, Santa Paula, California.

George Innes, president, Innes Shocker Co., Davenport, Iowa.

Robert H. MacDonald, manager, Philadelphia office, The Louden Machinery Co., Philadelphia, Pennsylvania.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the November issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Fred Schmidt Hoefer, power engineer, New York State Gas and Electric Corporation, Oneonta, New York.

Raymond Earl Storie, junior soil technologist, University of California, Davis, California.

Transfer of Grade.

Henry A. Wright, student trainee, J. I. Case Threshing Machine Company, Racine, Wisconsin.

Books Received

"Instruction Manual for Sheet Metal Workers," by R. W. Selvidge, professor of industrial education, University of Missouri, and E. W. Christy, director of industrial arts in the public schools of Cincinnati, is a new book intended as a text book for apprentices in the sheet metal industry and for pupils in trade schools, continuation schools, and other schools which give thorough and adequate instruction in sheet metal work. Employers and labor organizations will find it a most valuable guide in giving a definite outline of the instructions apprentices should receive. In making an analysis of the sheet metal worker's trade an effort has been made in this book to list the fundamental operations of the trade rather than the jobs of the trade. The book is divided into four distinct parts: (1) How to use the manual, (2) unit operations, (3) information topics, and (4) standard tables. The operations of the trade have been listed and definite directions given for performing each operation. These directions are followed by questions designed to make the learner think out the reasons why a thing is done in a certain way. The list of operations constitute the alphabet of the trade. A number of valuable tables are given as well as problems in drafting, lay-out, and construction, together with methods of solving problems. The book is published by The Manual Arts Press, Peoria, Illinois.

Employment Bulletin

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of Agricultural Engineering. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER open for position as sales engineer, salesman, advertising writer, or agricultural propagandist. Past experience with large agricultural firms. MA-124.

AGRICULTURAL ENGINEER, 1924 graduate of Kansas State Agricultural College, with farm experience, would like permanent employment at once, preferably with a farm-machinery manufacturer. MA-126.

AGRICULTURAL ENGINEER, 1925 graduate of College of Agriculture, at the University of Illinois, who has specialized in tractors and farm-power machinery and lubrication, and who has had eight years' experience in the operation, repair, and demonstrating of tractors and related farm machinery, desires a position preferably with a farm-machinery manufacturer or oil company. MA-127.

Positions Open

AGRICULTURAL ENGINEER to teach farm buildings, agricultural drawing, rural architecture, and to handle the extension work in farm buildings is needed at Virginia Polytechnic Institute, Blacksburg, Virginia. The work is so arranged that one-half time will be devoted to resident instruction and the other half to extension work. Most of the extension work at present is confined to actual designing of farm structures with some field work. A man is wanted who is capable of developing the extension phase of the work to the highest efficiency. Those interested should write C. E. Seitz, head of the department of agricultural engineering.

SALES ENGINEERS WANTED: One of the largest bearing manufacturers in America can use the services of two good sales engineers. Men with an engineering education and sales experience in farm tractor and implement field are preferred. They should have designing ability so that they can be of service to customers. Those experienced in the farm-implement and tractor design will be shown preference. Write fully giving all data as to experience, education and salary expected.

ENGINEER wanted, by one of the largest farm-machinery manufacturers, who is alive to the real engineering possibilities incidental to the manufacture of farm machinery, whose theoretical engineering training is complemented by a few years work at the drawing board in some engineering department and who will at once know the significance of routine efforts necessary to the accomplishment of any job in a production shop and be in position to appreciate the shop man's viewpoint. PO-111

EXTENSION AGRICULTURAL ENGINEER qualified to handle farm machinery and gas engine schools in various communities in the state, and also qualified to handle other lines of agricultural-engineering activity which an extension man is called upon to perform is wanted by the University of Nebraska. Candidates for this position should write O. W. Sjogren, chairman, department of agricultural engineering, Lincoln, Nebraska.

Directory of Professional Agricultural Engineers